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# Chemical Engineering

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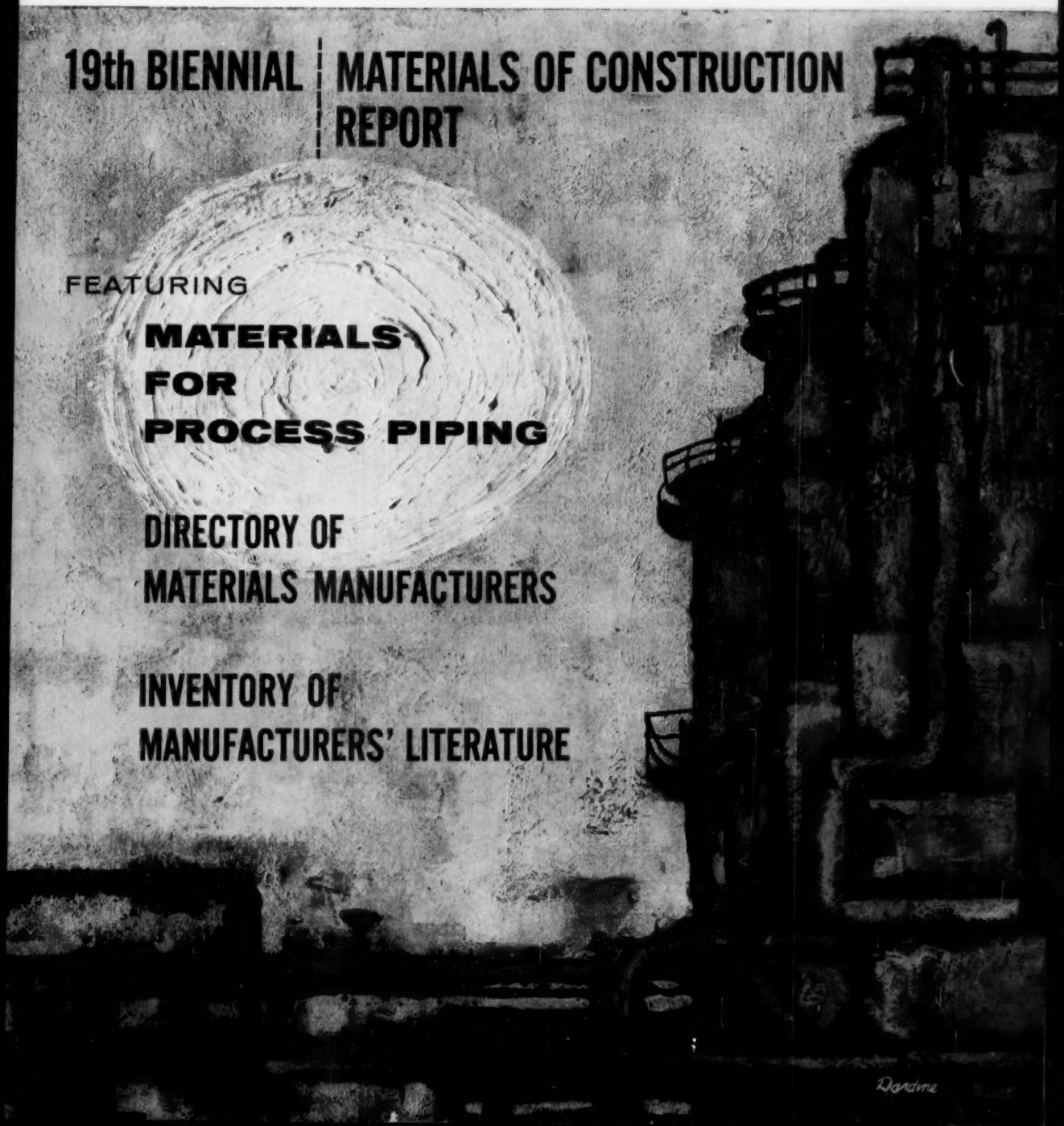
## 19th BIENNIAL REPORT | MATERIALS OF CONSTRUCTION

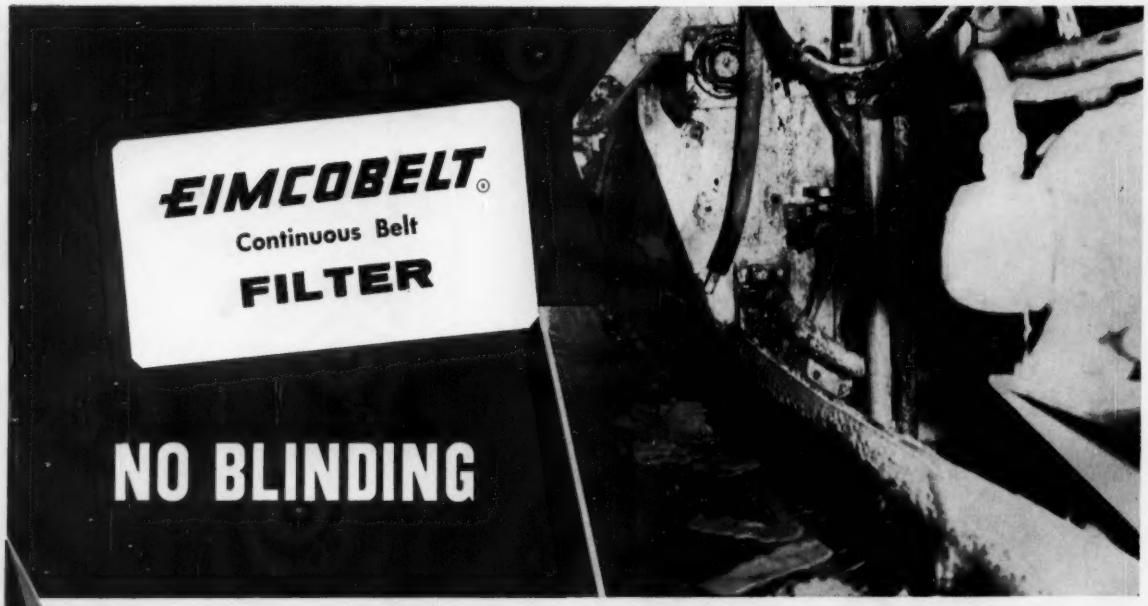
FEATURING

**MATERIALS FOR PROCESS PIPING**

DIRECTORY OF MATERIALS MANUFACTURERS

INVENTORY OF MANUFACTURERS' LITERATURE






# ...Filtering Difficult De-Inking Waste Sludge!

**In a paper recovery process in Wisconsin, wastes from old telephone books are settled out in a clarifier and the underflow sludge filtered on an EimcoBelt continuous belt filter. Extremely fine fiber and clay particles in these wastes make the sludge exceptionally difficult to filter.**

**The customer's engineers, knowing that frequent and excessive blinding of filter media would result on conventional drum filters, chose an EimcoBelt filter for the job on the basis of this filter's proven ability to maintain a clean medium handling similar difficult slurries.**

**With an EimcoBelt filter, operation is continuous, with no blinding and no fall-off in filtration rate.**

**The belt filter medium is continuously removed from the drum for cake discharge and cloth cleaning. High pressure wash sprays scour all traces of ink wastes from the filter medium while it is away from the drum. High filtration rates are obtained with little or no coagulant addition being required to condition the sludge.**

Because EimcoBelt filters maintain a constantly cleaned filter medium, difficult slurries that have never been filtered successfully on vacuum filters are now handled continuously and profitably. Even slurries having low solids concentrations, which ordinarily require thickening, have been filtered directly, with EimcoBelt filters.

**Ask the Eimco representative in your area for facts on how EimcoBelt filters can cut costs in your operations. Write Eimco Filter Division for Bulletin F-2053.**

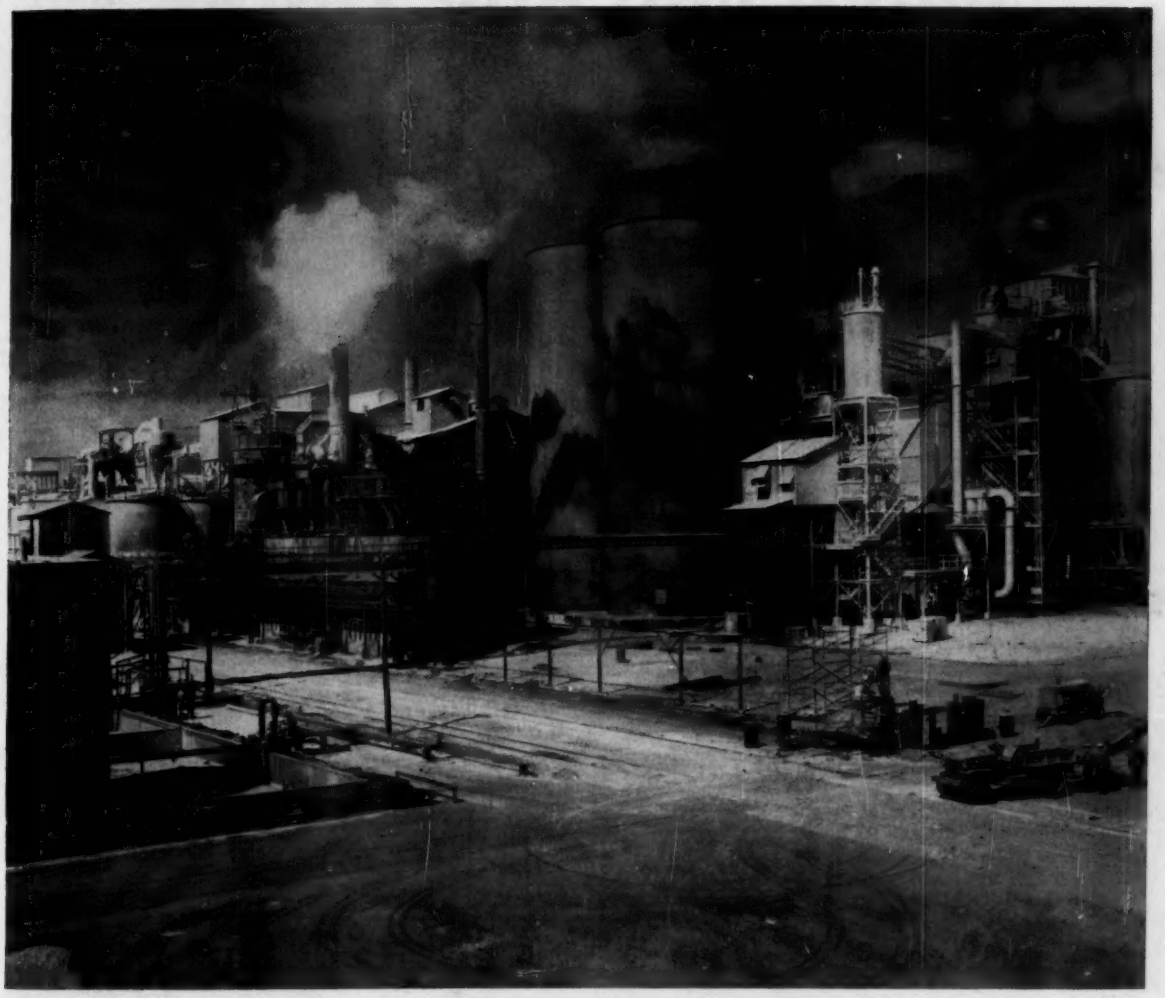
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654 SOUTH 4TH WEST
SALT LAKE CITY, UTAH — U.S.A.

RESEARCH AND DEVELOPMENT CENTER
381 SO. HICKS ROAD, PALATINE, ILLINOIS

B-664



# Rocks brewed in acid build bumper crops

IN big tanks at this plant, hot acid dissolves phosphate from ground-up rock, much like hot coffee dissolves sugar. This liquid is then drained away to make fertilizer. Ordinary metal tanks couldn't be used to hold the swirling mixture because rock would wear out the metal, acid would eat holes in it. They needed tanks tough enough to resist both acid and abrasion.

B.F.Goodrich engineers recommended lining steel tanks with special rubber compounds attached by the B.F.Goodrich "Unilock" process. The rubber lining is locked to the metal so strongly and tightly that it practically becomes a part of it. A square inch of it can stand a 500 pound tug without tearing loose. High temperatures don't affect it. Even if the acidproof rubber is punctured, the bond confines the damage to a small area where it can easily be repaired.

Thirty-five big tanks were rubber-lined by the B.F.Goodrich process—eleven of them so large they had to be lined at the plant. That was seven years ago. Since then the tanks have been in operation 24 hours a day, seven days a week, look good for many more years of service.

When you order tank linings, the true cost is the price divided by the years of satisfactory service. On that basis, your cost will be the lowest when you specify B.F.Goodrich. In the past 36 years, B.F.Goodrich has rubber-lined thousands of tanks to handle acids and other corrosives. Some are still in use; others lasted 15 to 20 years. Not one ever failed to end costly shutdowns for repairs. *B.F.Goodrich Industrial Products Co., Dept. M-935, Akron 18, Ohio, or Tuscaloosa, Alabama.*

**B.F.Goodrich**

**TANK LININGS**

# WHEN YOU BUY A BIRD




## What you see

is a clean, compact, ruggedly built, totally enclosed, continuous production unit

— a machine designed, built and tested to fit your specific requirements for:

**solids dryness**

**filtrate clarity**

**feed slurry consistency**

**feed volume**

**feed temperature**

**wash**

**fume tightness**

**pressure**

## What you don't see

are all the elements that contribute to the *certainty* that the Bird recommended for the job will do its work well and with continuous dependability and economy over a long period of time.

### *Among these hidden values are:*

- thirty years of concentrated experience on solid-liquid separation problems as the leading designer and builder of almost all types of equipment for this purpose
- a firm policy of maintaining interest in your installation and its successful operation, not just until it's paid for but as long as it's on the job
- Bird is in the business of building machines that run and keep on running rather than in building up a source of repair parts business

If this is your idea of the kind of equipment to buy, you'd BETTER BUY BIRD. Ask us to make recommendations and estimates based, if need be, on pilot scale test findings at the Bird Research and Development Center.

**BIRD** MACHINE COMPANY

**SOUTH WALPOLE, MASSACHUSETTS**

**BUILDERS OF THE COMPLETE LINE OF SOLID-LIQUID SEPARATING EQUIPMENT**

Operators of the **Bird Research and Development Center** for pilot-scale testing to determine the correct equipment for the job. Yours to use.

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# Chemical Engineering

November 14, 1960

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**Steam trap dependability is a matter of what the manufacturer puts into the trap**

# ARMSTRONG TRAPS ARE DESIGNED AND MADE TO GIVE YOU DEPENDABILITY

**1. Efficient, proved operating principle**



Armstrong Traps provide the most advanced development of the time-proven inverted bucket principle. Simple, but effective, there isn't much that can go wrong.

**2. Good design**



Armstrong Trap design gives big capacity in a small package. The mechanism is virtually fool-proof. All body styles are easy to inspect and maintain without removal from the line.

**3. Highest quality materials of construction**



Only the best goes into Armstrong Traps. Bodies are close grained 30,000 tensile iron castings or high quality forgings. Working parts are all tough, corrosion resistant stainless steel.

**4. Good workmanship**



Armstrong Traps are made by craftsmen who take pride in their work. Careful inspection and frequent checking insure the quality of the trap.

**5. Application know-how**




Your problem has probably been solved already in the extensive experience of the Armstrong engineering and sales organization. You can be sure of sound, dependable recommendations.

Your local Armstrong Representative can show you what Armstrong dependability can do for you. Call him today or write direct.



860 Series for low pressure heating service.



800 Series, side inlet, side outlet.



No. 801, side inlet, bottom outlet.



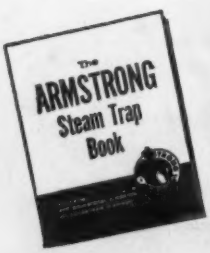
880 Series, integral strainer.



200 Series, bottom inlet, top outlet.



Forged Steel Series for high pressures, high temperatures.




The 48 page Armstrong Steam Trap Book tells how to correctly size, install and maintain steam traps for any pressure, any temperature, any load plus full catalog data on Armstrong Steam Traps. Ask for Catalog K.

**ARMSTRONG MACHINE WORKS**

**8587 Maple Street Three Rivers, Michigan**

*Chemical Engineering*
NOVEMBER 14, 1960

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# *Emphasis on Materials*

**Materials of construction take on added importance for chemical engineers today, with operating conditions becoming more severe and the squeeze on profits demanding more careful economic analyses when choosing the "best" material for a particular application. Our 19th biennial materials-of-construction report, in three parts, contains practical data and help for making technical and economic decisions.**

### COST ANALYSIS KEY TO CHOOSING PIPING MATERIALS

**The bewildering array of materials now available for process piping makes selection more complicated than just picking an alloy out of a corrosion table. Cost factors—for material, installation and maintenance—may dictate choice of a less-resistant material. Here is practical information on properties and economics of both metals and plastics (p. 183).**

### MATERIALS MANUFACTURERS AND WHAT THEY MAKE

**This regular feature of our biennial report lists 262 producers of important materials of construction for the chemical process industries. Here you'll find information on forms available, trade names, details on composition, grades and properties. Many new producers are included (p. 193).**

### MORE INFORMATION ON ALLOYS AND PLASTICS

**We are repeating this service, first offered in 1958. Here are over 550 items of current technical literature, offered by producers of materials of construction, with details about the contents of each bulletin or pamphlet (p. 214). To request your copies, use our Special Reader Service Card.**

R. B. NORDEN
J. R. MARSHALL

# MOBIL HELPS CHARDON RUBBER



**Oil life extended, lubrication costs slashed, maintenance techniques improved, equipment downtime reduced—average annual savings over four-year period: $6,928.**

The Chardon Rubber Company produces a wide variety of specialty items for industry. These items include thousands of precision-molded and -extruded rubber and plastic pieces of various shapes.

Quality control and accuracy are of prime importance at Chardon. And to maintain high level production and equipment performance, Chardon relies on Mobil lubricants and Mobil technical assistance. By suggesting oil re-use, by extending lubricant life, by recommending correct products and improved application techniques, Mobil has helped Chardon *save twice as much in maintenance costs as they have spent on Mobil Products.*

Interested in how Mobil may benefit you? Call your Mobil Representative. Or write: Mobil Oil Company, 150 East 42nd Street, New York 17, N. Y.

# SHAPE $27,713 SAVINGS!



**SAVED: $1,600.** With excessive carbon build-up causing faulty valve seating and an explosion hazard in three air compressors at Chardon, these compressors had to be opened up for valve cleaning or replacement an average of 10 times a year collectively. Mobil recommended correct cylinder lubricant and proper feed rates. Result: compressors have run over 4 years without overhaul.



**SAVED: $938.** Chardon Rubber encountered these problems in 42 molding presses: damaged packings, gasket failures, leaking valves and rusted rams and cylinder walls. By changing the hydraulic fluid formulation, Mobil has reduced these problems materially—saved Chardon $938 in 18 months.

**Mobil** **CORRECT LUBRICATION**

# What you should know about the economics of Reynolds Aluminum Process Pipe

Reynolds Aluminum Process Pipe—strong, lightweight, and corrosion-resistant—costs no more than cold rolled black steel or galvanized steel pipe, when you consider the total installed cost. For example, the table below shows that the base price of Reynolds Aluminum Heavy-End Pipe is almost as low as galvanized steel. Shipping and installation costs for aluminum pipe are invariably lower than heavier pipe—usually from 15 to 30% less.

**PIPE COSTS COMPARED**

| 4" Schedule 40 Pipe (Plain End) 100 feet | *Carload Price | Freight to West Texas from Eastern U.S. | Total |
|---|---|---|---|
| Black Steel | 98.37 | 15.86 | 114.23 |
| Galvanized Steel | 117.72 | 15.86 | 133.58 |
| Aluminum Heavy End* Alloy 6063-T6 | 143.75 | —(1) | 143.75 |
| Aluminum Alloy 6063-T6 | 179.15 | —(1) | 179.15 |
| Stainless Steel 304 Schd. 10 | 621.77 | 15.86 | 637.63 |
| Stainless Steel 304 Schd. 40 | 1065.80 | 15.86 | 1081.66 |

*Quoted as of March 25,1960 (1) Aluminum prices include delivery charges

The table also shows that aluminum pipe is the lowest-cost corrosion-resistant pipe you can buy. Reynolds Aluminum Heavy End Pipe costs about 1/4 as much as stainless 304, Schedule 10, and about 1/7 as much as stainless 304, Schedule 40.

### RESISTS CORROSION, WON'T RUST OR CONTAMINATE

The list of corrosive chemicals and process products that aluminum can handle is a long one, and it includes fluids that rapidly corrode other metals. Corrosion-resisting aluminum is ideal for process operations in the chemical, food, beverage, soap, drug, petroleum and petrochemical industries.

### LIGHTWEIGHT, BUT STRONG

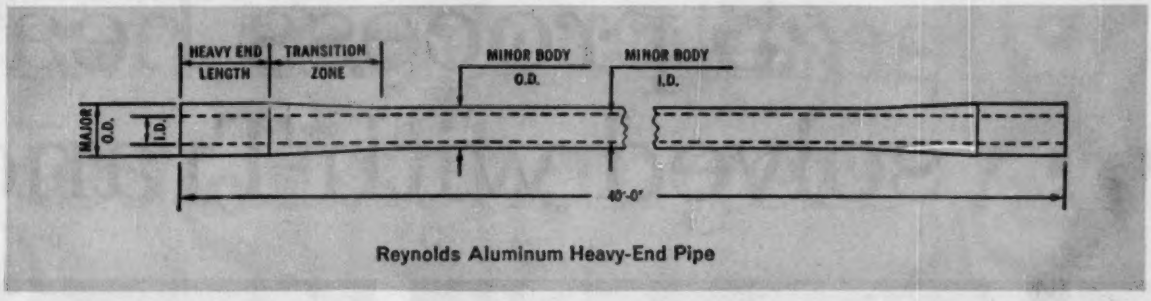
Only one-third as heavy as steel, Reynolds Aluminum Pipe costs less to handle, to ship, and to install. It requires less support, and is easier to move for temporary installations. Yet, aluminum is strong—strong enough to take rough handling and normal operating pressures. In fact, at lower temperatures (down to −320°F) where some metals grow brittle and weak, aluminum is actually *stronger*, with improved tensile and yield strengths, and ductility.

### EASY TO WORK, WELD, JOIN

Aluminum is one of the easiest metals to form, bend, cut and join. It welds speedily and securely by any common welding method. You can choose from a large variety of forged and cast aluminum fittings, flanges and couplings for grooved, threaded, and welded joints. This means more design flexibility, lower installation costs. Other unique characteristics of aluminum pipe are also important: It is nonsparking, safer to use with volatiles. And, the smooth inside surface of Reynolds Aluminum Pipe means less danger of scale formation—you get improved product flow that can hold pumping costs down.

### AVAILABILITY

Reynolds Aluminum Process Pipe is available in schedules 5, 10, 40 and 80. Diameters range from 1/8" to 12", and thicknesses range from .065" to .200". In addition, Reynolds Aluminum Pipe is available in both Duplex and Heavy-End types.




Reynolds Aluminum Heavy-End Pipe

### REYNOLDS DUPLEX PIPE

Reynolds Duplex Pipe is actually a two-pipe steam trace system in one. A dividing wall inside the tube provides two separate channels—one for steam or condensate, the other for the viscuous product. Duplex eliminates an outside steam line and the cost of fastening the two pipes together, and it minimizes insulation needs.

### HEAVY-END PIPE

Reynolds Aluminum Heavy-End Pipe can save up to 28% in piping costs. Heavy-End Pipe, with a constant inside diameter, is thicker at the ends to compensate for the loss in mechanical properties due to welding or grooving. Excess metal is eliminated in the pipe body and extra strength is provided where it's needed most—at the joint. It enables you to design a uniformly strong system without paying for extra metal, without overdesigning. Heavy-End Pipe is available in schedule 40 and 80 equivalents, and takes standard fittings.

### REYNOLDS—FOR ALUMINUM PIPE, ALUMINUM KNOW-HOW

When designing any process system, plan for economy and long, efficient service; plan with Reynolds Aluminum Process Pipe. For details, contact your local Reynolds office, or write for complete file on the uses of aluminum in the chemical process industry. Use coupon below.




Reynolds Aluminum Duplex Pipe

### REYNOLDS ALUMINUM SPECIALTY PIPE DISTRIBUTORS

A. B. Murray Company, Elizabeth, New Jersey

Boston Pipe & Fittings Company, Inc.
Cambridge, Massachusetts

Gulf Coast Marine Supply Company
Mobile, Alabama; Pensacola, Florida

Industrial Piping Supply Co., Charlotte, N.C.

McJunkin Corporation, Charleston 22, West Virginia

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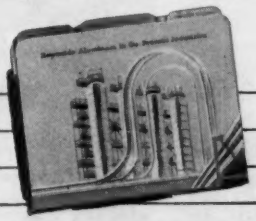
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St. Louis, Mo.; Kansas City, Mo.

Watch Reynolds new TV show "Harrigan & Son", Fridays; also "All Star Golf", Saturdays—ABC-TV.

REYNOLDS ALUMINUM

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# 5 process heat solved with Trane



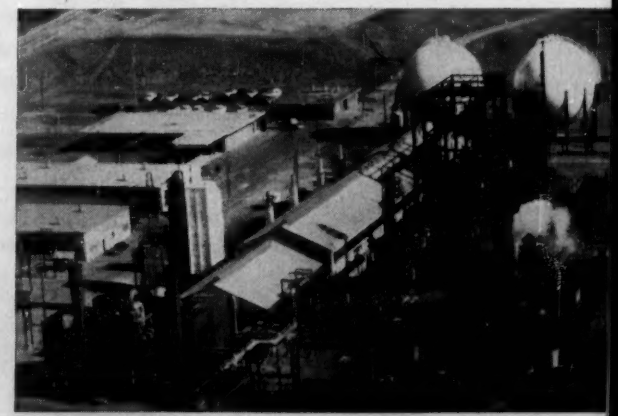
**Air Reduction Company** designed its Butler, Pennsylvania liquid oxygen plant around TRANE Brazed Aluminum Heat Exchangers, *obtaining efficient, economical heat exchange.* In this cold box, air and nitrogen streams are reversed on a 10-minute cycle to clean up condensed water, ice, $CO^2$ and other impurities.




**Foster Wheeler Corporation** designed this synthetic nitrogen plant for Deere & Company. They report that the TRANE Heat Exchange equipment *has operated four years without trouble of any kind.*



**Many refineries solve water problems** by *air-cooling* liquids, gases and condensing vapors with TRANE Fluid Coolers. Also widely used in chemical, petroleum and natural gasoline plants, TRANE Air Coolers cut real estate costs and maintenance expense. And while they cost no more than other types of cooling equipment, they have a far greater life expectancy.



**Spencer Chemical's** Vicksburg, Mississippi plant has achieved more economical production of ammonia and related chemicals with the Texaco-HRI methane process—using TRANE Brazed Aluminum Heat Exchangers. Temperature approaches as close as 5° F *reduce power costs for refrigeration;* compact design cuts space and construction costs.

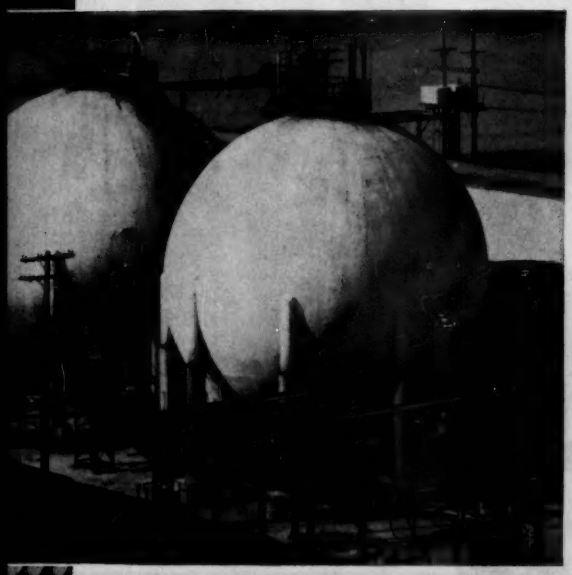
# transfer problems Heat Exchangers

Every year, more and more plants are relying on TRANE Heat Transfer equipment for a wide variety of process applications. These plants report that TRANE Heat Transfer equipment helps them in five important ways:

- **Reduced refrigeration costs**
- **Close temperature approaches**
- **Efficient, economical heat exchange**
- **Trouble-free operation**
- **Elimination of water problems (with TRANE Fluid Coolers)**

TRANE Brazed Aluminum Heat Exchange equipment is lightweight, compact—packs 450 sq. ft. of heat exchange surface into 1 cubic foot. Its performance characteristics give you temperature approaches as close as 5° F. Rugged and dependable, it withstands operating pressures as high as 600 psig. And you cut space and construction costs, too, because a typical cold box with TRANE Brazed Aluminum Exchangers requires only *half as much space* as one with conventional heat transfer equipment!

If you have a process heat transfer problem, turn to TRANE. Over thirty years of varied heat transfer experience is at your service! Ask your TRANE Sales Office for information, or write directly to TRANE, La Crosse, Wisconsin.



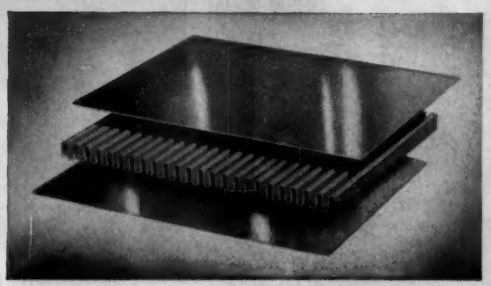
***For any air condition, turn to***

# TRANE

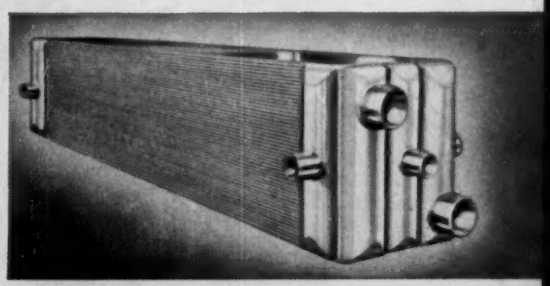
MANUFACTURING ENGINEERS OF AIR CONDITIONING, HEATING, VENTILATING AND HEAT TRANSFER EQUIPMENT

THE TRANE COMPANY, LA CROSSE, WIS. • SCRANTON MFG. DIV., SCRANTON, PA. • CLARKSVILLE MFG. DIV., CLARKSVILLE, TENN. • TRANE COMPANY OF CANADA, LIMITED, TORONTO • 97 U. S. AND 18 CANADIAN OFFICES

**The Atlantic Refining Company** reports *temperature approaches of 5° F* plus 99.99% pure anhydrous ammonia in their Philadelphia plant—using fifty TRANE Brazed Aluminum Heat Exchangers.



**Lightweight, compact** TRANE Brazed Aluminum consists of corrugated aluminum sheets brazed together to form a stack of layers which form individual passages for the flow of fluids or gasses. Provides up to *nine times* the surface per square foot of shell-and-tube exchangers!



**Headered for 5-stream operation,** this TRANE Brazed Aluminum Heat Exchanger can handle as many as five fluids simultaneously. Units are available for either cross-flow or counter-flow operation. Surface can be fabricated in a wide variety of shapes and sizes to meet all types of requirements.

## ADDED VALUES

### QUALITY CONTROL

Quality control influences every G.E. operation, from order receipt to shipment.

### PRODUCT INNOVATION

Product research and development is advanced in all 98 G.E. laboratories.

## *System Planning*

Customer-oriented application engineers assist you with systems integration.

### ANALYTICAL ENGINEERING

The latest tools of process analysis are available for studies of your problems.

### INSTALLATION AND SERVICE ENGINEERING

Expert on-site assistance gives you smoother installation and earlier start-up.

### SYSTEM CO-ORDINATION

G.E.'s systems experience focuses the full Company capabilities on your order.

### NATION-WIDE SERVICE SHOPS

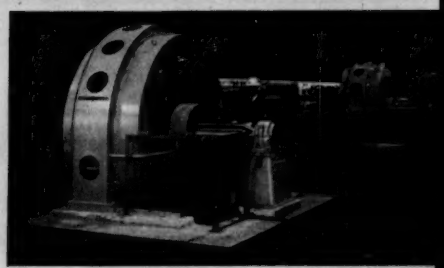
More than 50 G.E. Service Shops offer you 'round-the-clock maintenance service.

### PROMPT DELIVERY

Accurate delivery cycles put your new G.E. equipment to work for you—on time.

### VALUE ANALYSIS

Value Analysis gives you optimum combination of product value and economy.



**G-E SYNCHRONOUS MOTORS** give you lowest-cost shaft power for many compressor and blower applications. Initial cost is low, efficiency is high, and installation is fast and inexpensive.

# How General Electric System Planning Helps You Reduce Process Costs

Today's cost squeeze in the petroleum and chemical process industries can be minimized when the experience and know-how of General Electric system planners is used in selecting your key process drives. G-E system planners will analyze your processes and help you design systems in which equipment capabilities are efficiently and economically matched to your particular process requirements. By taking advantage of G-E engineering assistance during the earliest planning of your new processes, you will be able to give well-defined systems guidance to your engineering contractor or consultant.

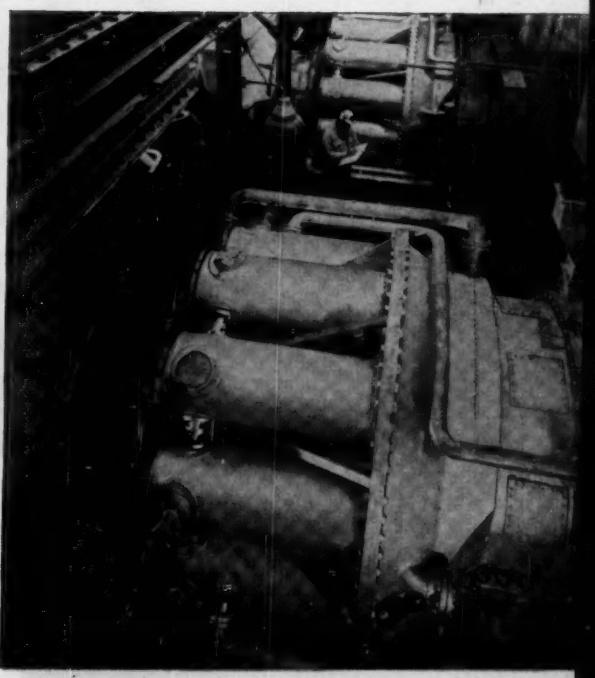
**FOR EXAMPLE, GENERAL ELECTRIC SYSTEM PLANNERS** recently recommended three gas turbines to drive key compressors and blowers at a new ethylene process plant. These three 13000 hp G-E turbines are not only providing reliable shaft power but also a power bonus by economically supplying hot gas for heating process air and making steam. Designing such flexible, cost-saving equipment into your process system at the very beginning can also reap big operating benefits from your investment.

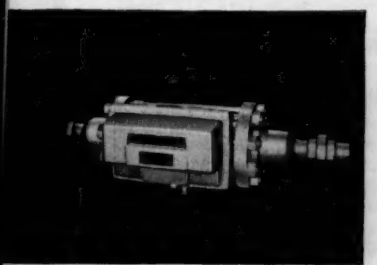
**FOR DETAILED INFORMATION** on how General Electric system planning can help reduce your process costs, call your local General Electric Industrial Sales Office. General Electric Company, Schenectady 5, N. Y. 651-02

*Progress Is Our Most Important Product*

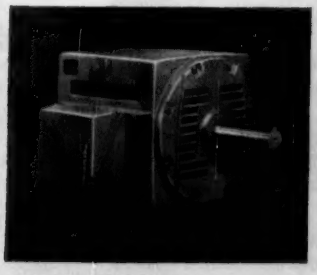
**GENERAL ELECTRIC**

**GENERAL ELECTRIC GAS TURBINES** recently installed at a new ethylene process plant are providing reliable, continuous service plus a power bonus by supplying hot exhaust gases for making process steam. Application of G-E gas turbines in your process system can provide similar operating benefits.





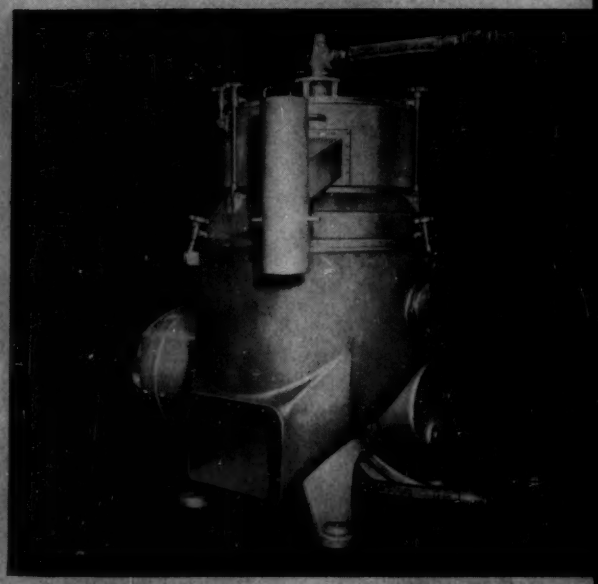
**NEW TRUE MASS FLOWMETER** measures fluid streams directly in pounds, eliminates the time-consuming—and sometimes erroneous—conversion of volume to weight.



**NEW CUSTOM '8000'*** motors with special Polyseal* insulation systems may permit you to use lower-cost enclosures.

*Trade-mark of General Electric Co.

# De Laval tackles process problems



## ...economically!

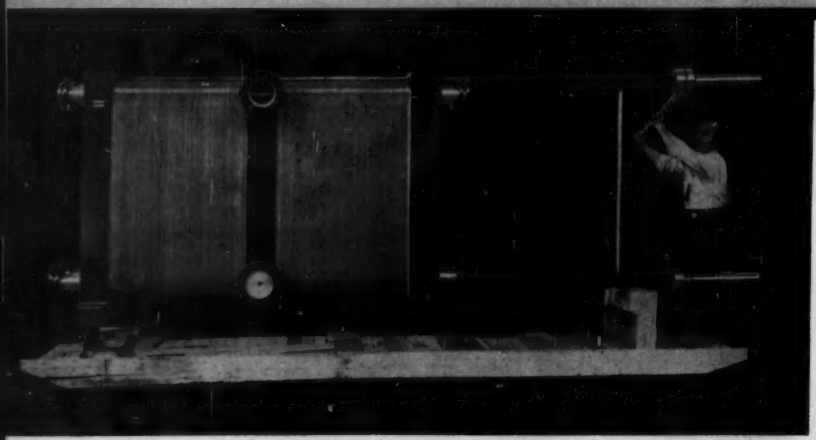
For Further Information Write To Dept. C-11A

**DE LAVAL**

THE DE LAVAL SEPARATOR COMPANY
Poughkeepsie, New York
5724 N. Pulaski, Chicago 46, Illinois

DE LAVAL PACIFIC COMPANY, Dept.
201 E. Millbrae Avenue, Millbrae, Calif.

CENTRIFUGES
PLATE HEAT EXCHANGERS
VIBRATING SCREENS
COMPLETE PROCESSES



## A sticky problem with a hot solution

**Problem:** To heat a solution of 45% Latex concentration from 117°F to 170°F without precipitating excessive coagulum.

**Solution:** De Laval Plate Heat Exchanger. Shell & Tube exchangers could not be used; they'd be impossible to clean. Instead, this company installed a two section De Laval Plate Heat Exchanger, each section handling 114,500 pounds per hour of the latex concentration. With Type 316 stainless steel plates and a total heat transfer surface of 1,090 sq. feet, the unit has been in operation (and operating perfectly) for almost two years.

Even in processing of a solution as sticky as latex, the De Laval Plate Heat Exchanger is cleaned *in place* by circulation of a cleaning solution immediately following the heating of the latex. For periodic cleaning other than by circulation, the plate pack is easily opened. All heat transfer surfaces are immediately exposed for manual cleaning with a minimum of trouble.

## Processor of new detergent cleaned up recovery problem with fast, non-stop separator

**Problem:** A processor developing a new detergent made from vegetable oil needed an efficient method of recovering the expensive catalyst in re-usable form. Previous attempts had recovered non-dispersible catalyst in a hard cake form.

**Solution:** A De Laval AC-VO "Nozzle-Matic" Centrifuge. Since the heavy phase in the separation (containing the catalyst) is thrown to the bowl wall and discharged *continuously* as part of the machine's normal operation, the catalyst is recovered in a thick slurry. In this form, it is easily re-dispersed.

This particular unit was also supplied with a heavy phase recirculation feature. As the heavy phase is discharged through the nozzles built into the bowl wall, it is picked up and recirculated to the centrifuge bowl. The result is a higher concentration of the catalyst, and in a state of maximum clarification.

The higher capacities possible with De Laval continuous discharge centrifuges were important to this processor, too. Combined with the fast operation, they insured maximum catalyst life. Slow operation had been a factor in the hard caking of the catalyst in previous attempts at recovery.

Wherever recovery of a solid is important in your process, you should consider the different types of solids concentrators we make at De Laval. There is a type for every recovery operation.

Why not drop us a line for further information? Just tell us the type of recovery which interests you. There is no obligation, of course.

## ONE PROBLEM AFTER ANOTHER



"Most process engineers are in the 'problem business.' Ours are too – up to their necks!

"Often, our experience and extensive performance data permits on-the-spot solutions to these problems. At other times, pre-testing process conditions in our own pilot plant pins down the best equipment type – the most economical size. Examples are shown here of how De Laval's experience and facilities have served others – could serve you!"

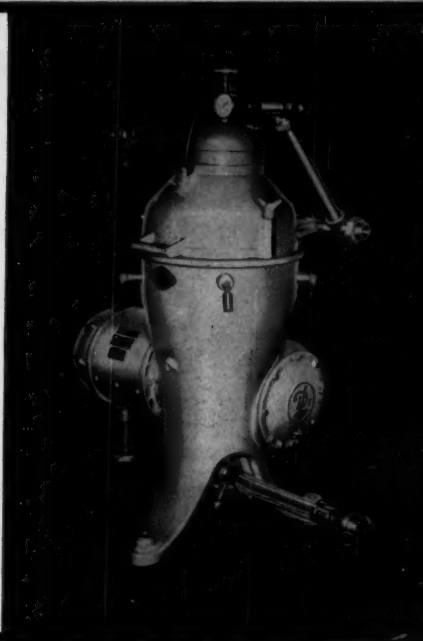
**Fred Wheelwright, Industrial Sales Manager**

## Viscous liquid easily separated in pressurized centrifuge

**Problem:** A viscous, high-melting-point rubber accelerator was to be separated from an alcoholic reaction mixture.

**Solution:** Centrifugal separation at liquefying temperatures. This also meant maintaining pressure to avoid alcohol boil-off. An open-system separation was not practical but tests at De Laval's pilot plant proved the Hermetic Centrifuge could handle this job. In actual production, instantaneous and complete separation was easily achieved with a De Laval Hermetic Centrifuge to provide a clean product and no loss of the alcohol phase.

Similar separation problems involving elevated temperatures and pressures can be handled by the many standard types of De Laval Hermetics. Corrosion-resistant and easy to clean, these centrifuges meet all the requirements of industrial service. As in the case quoted here, our technical service in providing the *right* design for volume and purity requirements often includes pilot plant pre-testing before shipment. Please write for details.



# NEW

## CLAYTON MARK

# Parkerized

# FITTINGS

- **RUST PROOF, CORROSION-RESISTANT**
- **CARBON AND ALLOY**
- **SCREWED AND SOCKET WELD**
- **2000, 3000, 4000, 6000 p.s.i.**

Now you can buy a complete line of *Parkerized* Fittings from the same source that has supplied you with high pressure Unions and Valves since 1912. In sizes 1/8" to 4", these forged steel, clean-looking fittings resist corrosion "forever" on shelf or in high-pressure steam, water, oil, gas and air applications. Eliminate duplicate paperwork . . . order all your piping requirements from your Clayton Mark Distributor. Have the best yet save time and money —specify Clayton Mark!

**AVAILABLE IN 50 STATES AND THROUGHOUT THE WORLD**

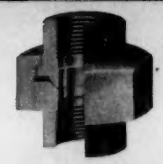
# CLAYTON MARK

AND COMPANY

**1914 DEMPSTER STREET · EVANSTON, ILLINOIS · U.S.A.**

PUMPS · WATER WELL SUPPLIES · CONDUIT · UNIONS · TUBING

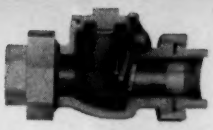
## HOT FORGED STEEL HIGH-PRESSURE UNIONS AND VALVES



"PETRO" CARBON STEEL UNION



PETRO" STAINLESS STEEL UNION



SWING CHECK VALVE



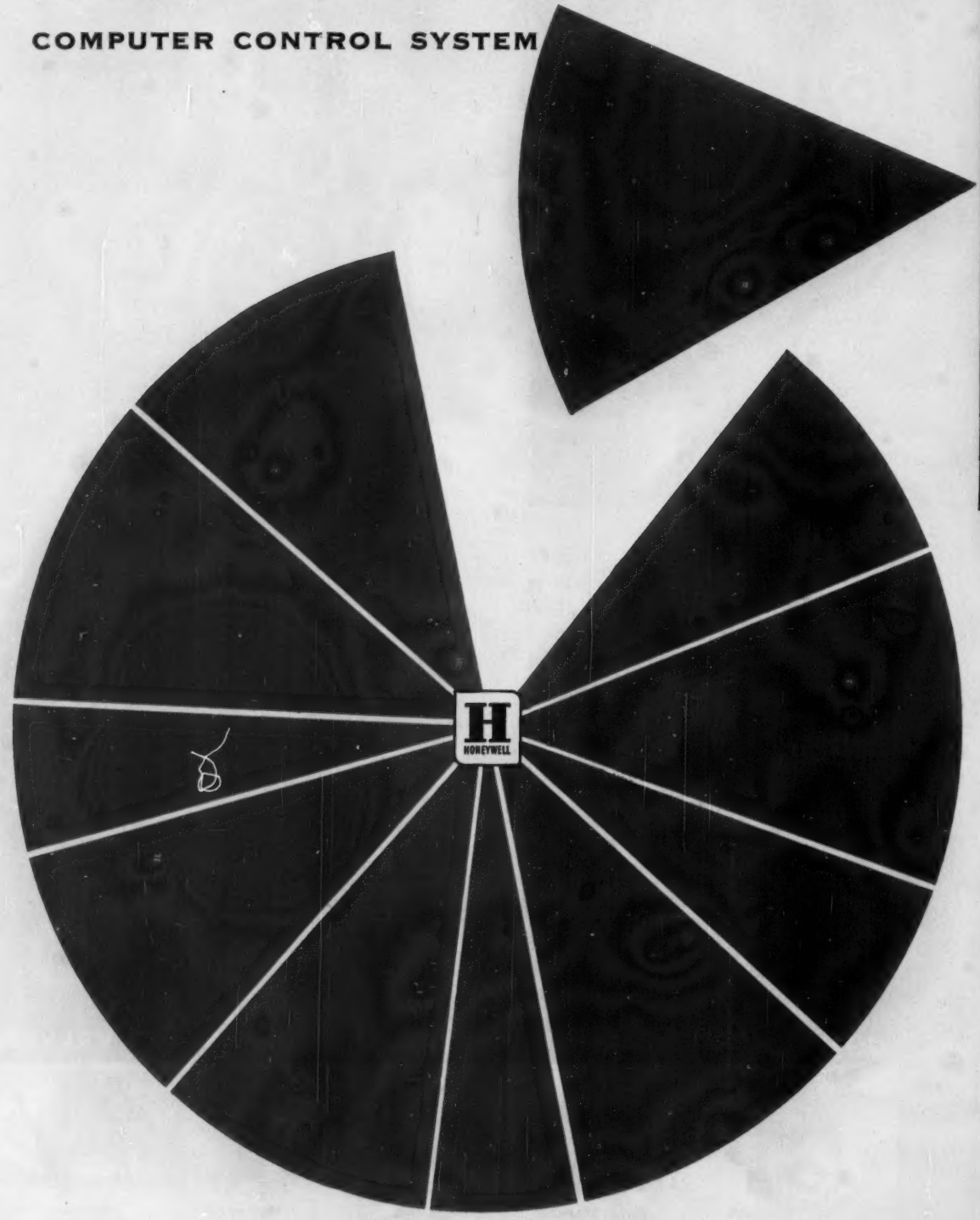
"PETRO" CHECK VALVE

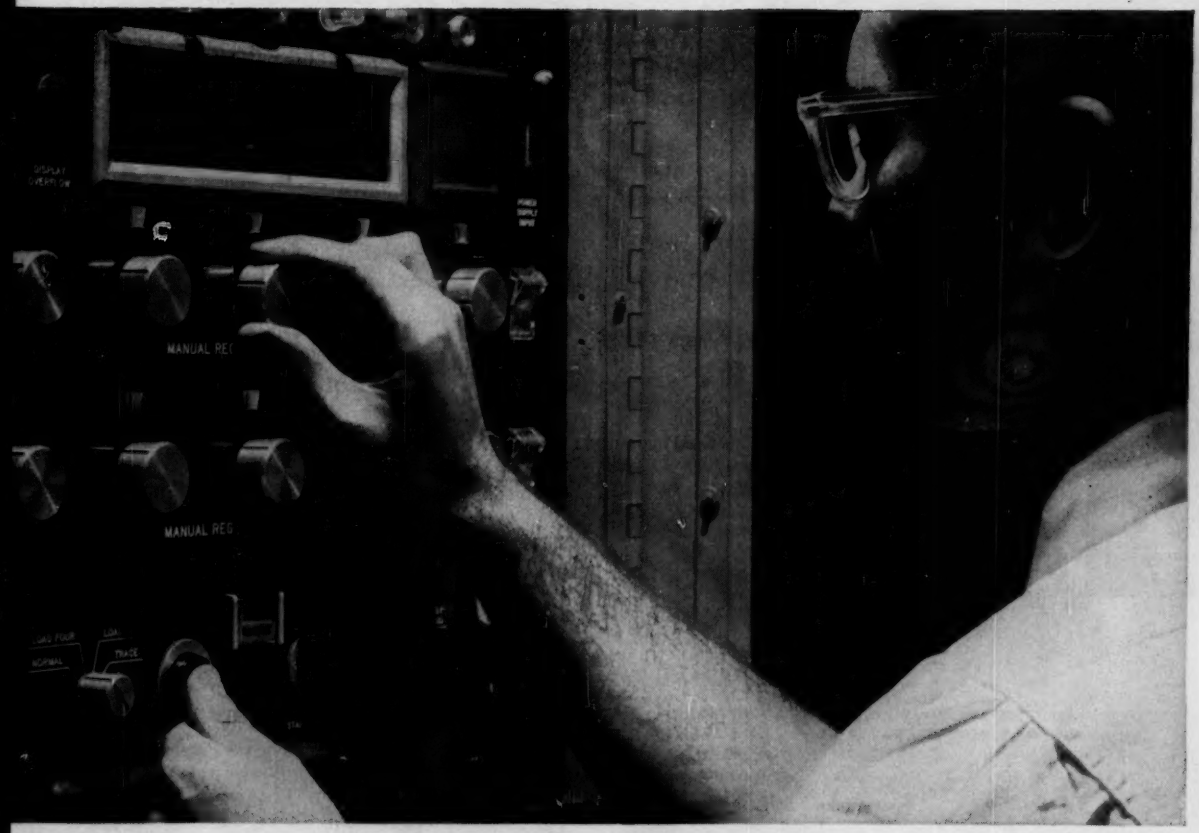


"BEVELED" ORIFICE UNION

**NEW HONEYWELL 290 INDUSTRIAL DIGITAL COMPUTER**

**. . . HEART OF THE FIRST COMPLETELY INTEGRATED COMPUTER CONTROL SYSTEM**





**Single-Source Responsibility.** Now you can get the first truly complete computer control package produced by a single manufacturer. The new, all-solid-state Honeywell 290 Industrial Digital Computer rounds out Honeywell's broad line of instrumentation, and enables you to specify an all-Honeywell process control system. That means you're protected by single-source responsibility . . . from primary elements to final controls, from initial concept through maintenance.

**High Speed plus Reliability.** This new computer is the most powerful in its field. Typical operation rates: 8,000 additions, 1,250 multiplications, or 400 square root extractions per second. This high-speed computing of currently pertinent data gives you precise process control. Simplified programming adapts the computer easily to process changes. All-solid-state design and extensive system self-checks are engineered into every circuit and every unit of the computer.

**Application Experience plus Computer Know-How.** With the addition of the Honeywell 290 computer to the world's most extensive line of measuring and control equipment, Honeywell systems engineers now have the tools to implement all applications including those requiring computer control.

Take advantage of Honeywell's 75 years of experience in industrial process control. Get the advantage of having your entire system under Honeywell's overall responsibility.

MINNEAPOLIS-HONEYWELL, Wayne and Windrim Avenues, Philadelphia 44, Pa. In Canada, Honeywell Controls, Ltd., Toronto 17, Ontario.

75th YEAR

ENGINEERING THE FUTURE

**Honeywell**

First in Control

SINCE 1885



## ENGINEERED TEFLON* PRODUCTS
for Chemical Processing

### BEST AT EXTREME TEMPERATURES WHERE CORROSIVES ARE PRESENT

**Garlock Teflon-jacketed Gaskets** give you the advantage of using Teflon without sacrificing resiliency and deformability . . . particularly important on your glass-lined process equipment, light metal flanges, and glass pipe flanges and fittings. Garlock offers four basic designs—slit envelope, milled envelope, formed shield, double jacket —and a wide selection of filler materials and thicknesses. Catalog AD-154.

**Garlock SOLID Teflon and Teflon-lined Expansion Joints,** exposed to the most reactive chemicals, guard costly piping against pressure surges from pumps, compressors and engines . . . reduce flange breakage, prevent stress, compensate for misalignment. Catalog AD-137.

**Garlock LATTICE-BRAID† Teflon Packings** are perfect on pumps and engines in petrochemical, oil and gas service. They are strong, long-lasting, chemically inert. Withstand temperatures ranging from −120°F to +500°F. Less gland pressure is required to effect an adequate seal, resulting in longer sleeve and packing life, less downtime. Catalog AD-131.

**Garlock CHEMISEAL† Mechanical Seals** possess greater immunity to corrosion and are more economical than any other design offered. Easy to handle and install, do not score shafts, engineered to give a life expectancy many times that of other seals. Available in standard sizes to fit all pump shafts $\frac{7}{8}$" to $2\frac{1}{8}$" shaft. Seals against all media in pressures to 100 psi at 75°C or 75 psi at 100°C. Catalog AD-164.

# GARLOCK

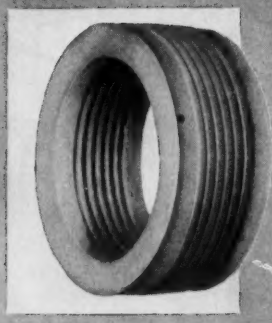
**For more complete information,** call your Garlock representative at one of Garlock's 26 sales offices and warehouses throughout the U.S. and Canada. Or, write Garlock Inc., Palmyra, New York.

**Canadian Div.:** Garlock of Canada Ltd.

**Plastics Div.:** United States Gasket Company

**Order from the Garlock 2,000** . . . two thousand different styles of Packings, Gaskets, Seals, Molded & Extruded Rubber, Plastic Products

†Registered Trademark
*DuPont Trademark for TFE Fluorocarbon Resin



**Teflon Expansion Joints** protect expensive piping from damage due to stress, misalignment . . . resist solvents, acids, caustics to 125 psi.



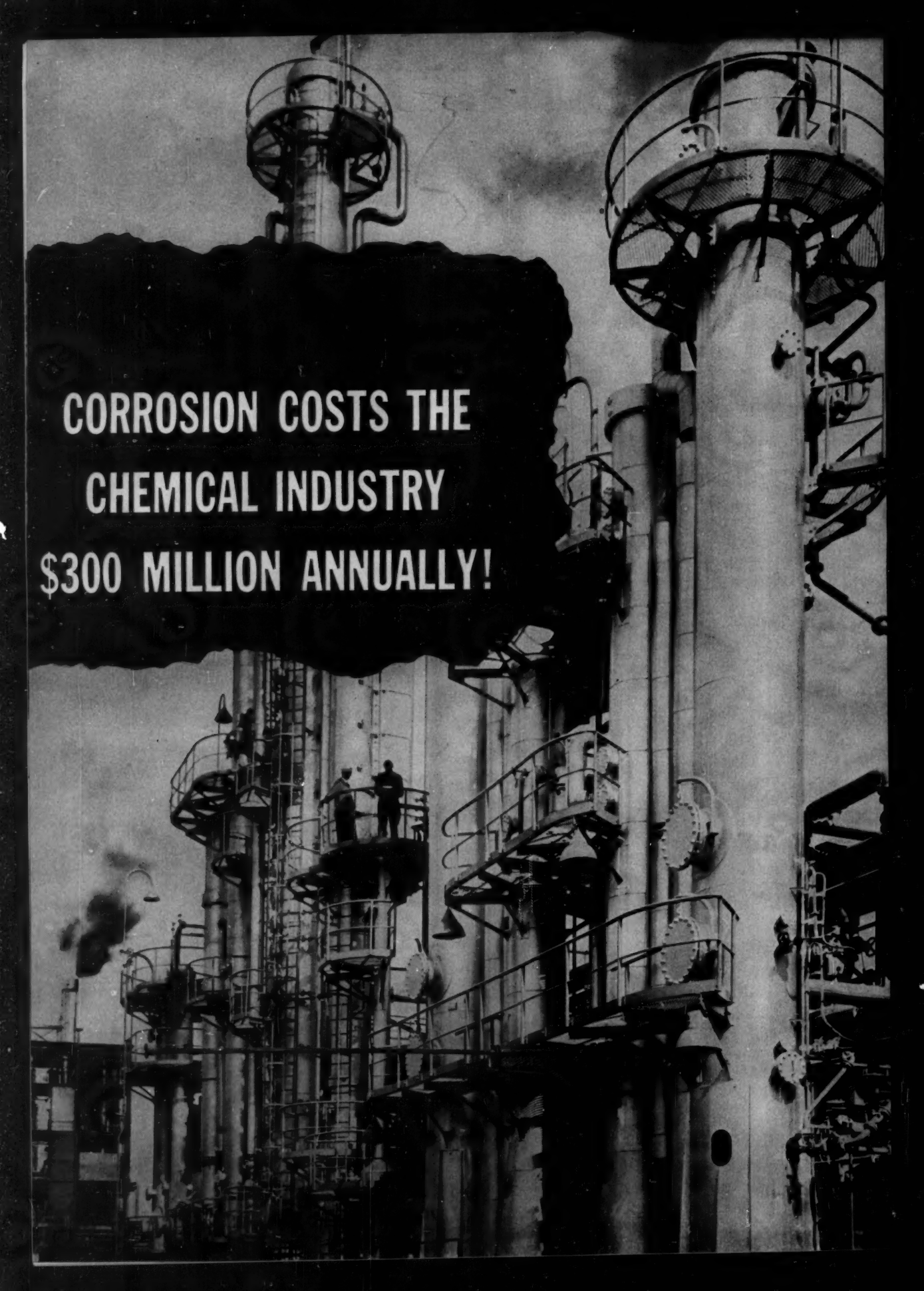
**CHEMISEAL Mechanical Seals** can be installed quickly and simply, offer leakproof sealing without shaft wear . . . resist most reactive chemicals.



**LATTICE-BRAID Teflon Packing** lasts far beyond the limits of other packings . . . gives maximum service over wide range of temperatures, pressures. Only Garlock can give you LATTICE-BRAID.

**Teflon-jacketed Gaskets** offer the advantage of applying Teflon without the loss of resiliency . . . ideally suited to pipes, flanges in chemical processing.




CORROSION COSTS THE
CHEMICAL INDUSTRY
$300 MILLION ANNUALLY!

# ...Now You Can Control 88% of All your Chemical Corrosion Problems with this Proven PITT CHEM® Coating System!

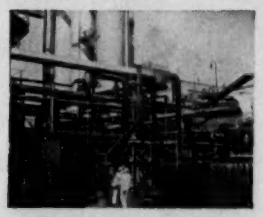
Probably no other industry in the nation is confronted by the variety and severity of corrosion conditions faced each day by the chemical processing industry. Corrosion engineers estimate that the annual toll in equipment and plant facilities is nearly one-third of a billion dollars.

Pittsburgh now provides the chemical industry with a complete *system* of PITT CHEM heavy-duty protective coatings which will efficiently and economically control nine out of every ten corrosion conditions in your plant —from simple atmospheric corrosion to severe chemical attack. Service-proven PITT CHEM cold-applied coatings are now "on guard" in hundreds of chemical processing plants, adding years of valuable service life to storage tanks, piping systems and other equipment where "impossible" corrosion conditions once existed.

PITT CHEM Tarset, Tarmastic and Insul-Mastic are tough, *thick film* coatings that outlast conventional maintenance paints 10 to 20 times. You measure their protection in *decades*, not years. They can be cold-applied by brush, spray gun or roller. No other system of protective coatings can solve so *many* of your corrosion problems so *economically*.

For more information, mail the coupon below. Then consult your nearest PITT CHEM Distributor—he's listed in the "Yellow Pages." Or call Pittsburgh Coke & Chemical Co. in Pittsburgh, New York, Chicago, Houston or Los Angeles. A PITT CHEM Corrosion Engineer will discuss your corrosion problems without obligation.

## PITT CHEM TARSET®



The original, patented coal tar-epoxy coating, Tarset is now solving many of the severest corrosion problems in the chemical industry. Years of service as lining for acid and alkali tanks, and on piping and structural steel, have proven the revolutionary ability of Tarset to withstand extreme chemical corrosion.

## PITT CHEM TARMASTIC®



PITT CHEM Tarmastic coal tar coatings are a series of thick-film protective coatings designed to solve a wide variety of corrosion problems at moderate cost. Excellent for protection of hoods, fans, housing and other equipment against steam and very corrosive vapors, mild acid and alkaline solutions and extreme moisture conditions.

## PITT CHEM INSUL-MASTIC®



Vapor and moisture penetration problems are solved economically and effectively with time-tested Insul-Mastic Gilsonite-asphalt coatings. Ideal for the protection of metal, concrete and masonry surfaces against weather, moisture and many chemicals and vapors. Insul-Mastic cork mastics provide good insulating qualities and condensation control.

## PITT CHEM PIPELINE ENAMELS



For the long-term preservation of underground pipelines, coal tar enamels are considered the most practical and effective method of protection ever developed. PITT CHEM Pipeline Enamels are widely recognized for their excellent quality and service record on oil, gas and water transmission and distribution lines throughout the nation.



**Send for Your Free Copy of this CHEMICAL CORROSION DATA FILE**

Includes a survey of corrosion problems in the Chemical Industry, data on PITT CHEM Coating Systems and a coating selector guide. Write for your copy today.

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*Reporting more news from . . .*

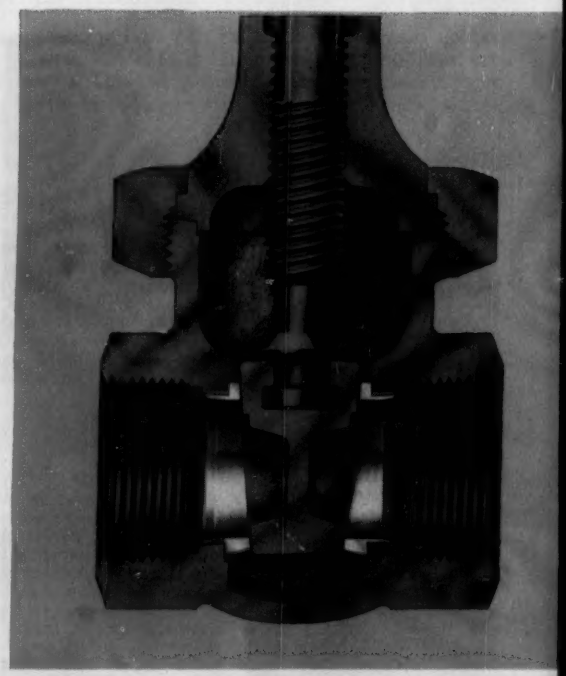
**CRANE**
***DIRECTION '70***

**. . . a fast-moving program of planned expansion, product development, and streamlined distribution to help our customers meet the competitive challenges of the Sixties.**

# Only from Crane—this rugged bronze valve in a full range of pressure classes and sizes

Use these on your toughest services! Here are valves with a built-in safety factor that far exceeds minimum standards. Modern, cylindrical body design—the same as used on high-pressure steel valves—gives you extra protection against body distortion that causes leaks. Crane Exelloy seat rings defy operating wear and damage from foreign matter... drastically reduce your valve maintenance costs. And you get this extra performance at no more cost than you pay for a valve built to only minimum standards.

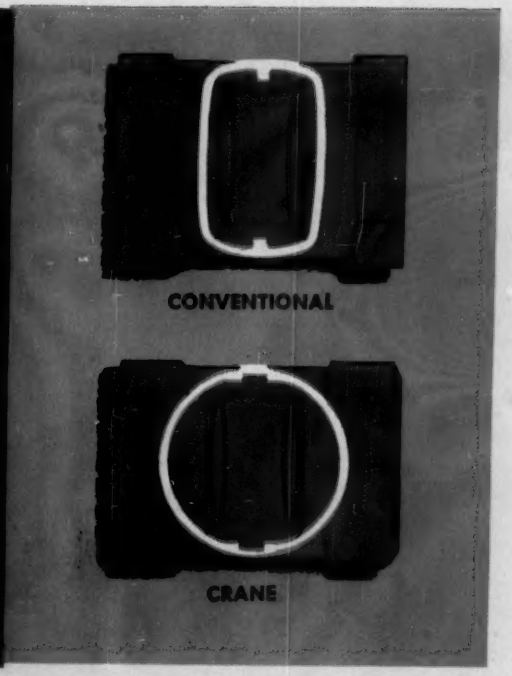
In addition to all these quality features, Crane gives you a far wider selection than any other comparable bronze valve line . . . a full range of sizes from ¼" to 3" . . . in both 200-pound and 300-pound pressure classes . . . in both rising stem and non-rising stem patterns. Your local Crane Distributor has these valves in stock and can ship your order without delay.



**THANKS TO EXELLOY SEATS, ONLY THE REPLACEABLE DISC GETS THE WEAR**

Crane Exelloy (12% chromium steel) seat rings, expanded into body, give a hard bearing surface with superior resistance to wear, indentation, or scoring. Normal seating wear is shifted to the easily replaceable bronze wedge disc. Ordinary bronze valves wear on both disc and seat, an expensive maintenance factor. But with this Crane bronze valve you need only slip in a new disc to get a like-new, tight-seating valve.






**"BEEFED-UP" BODY DEFIES DISTORTION TO MAINTAIN TIGHT SEAL**

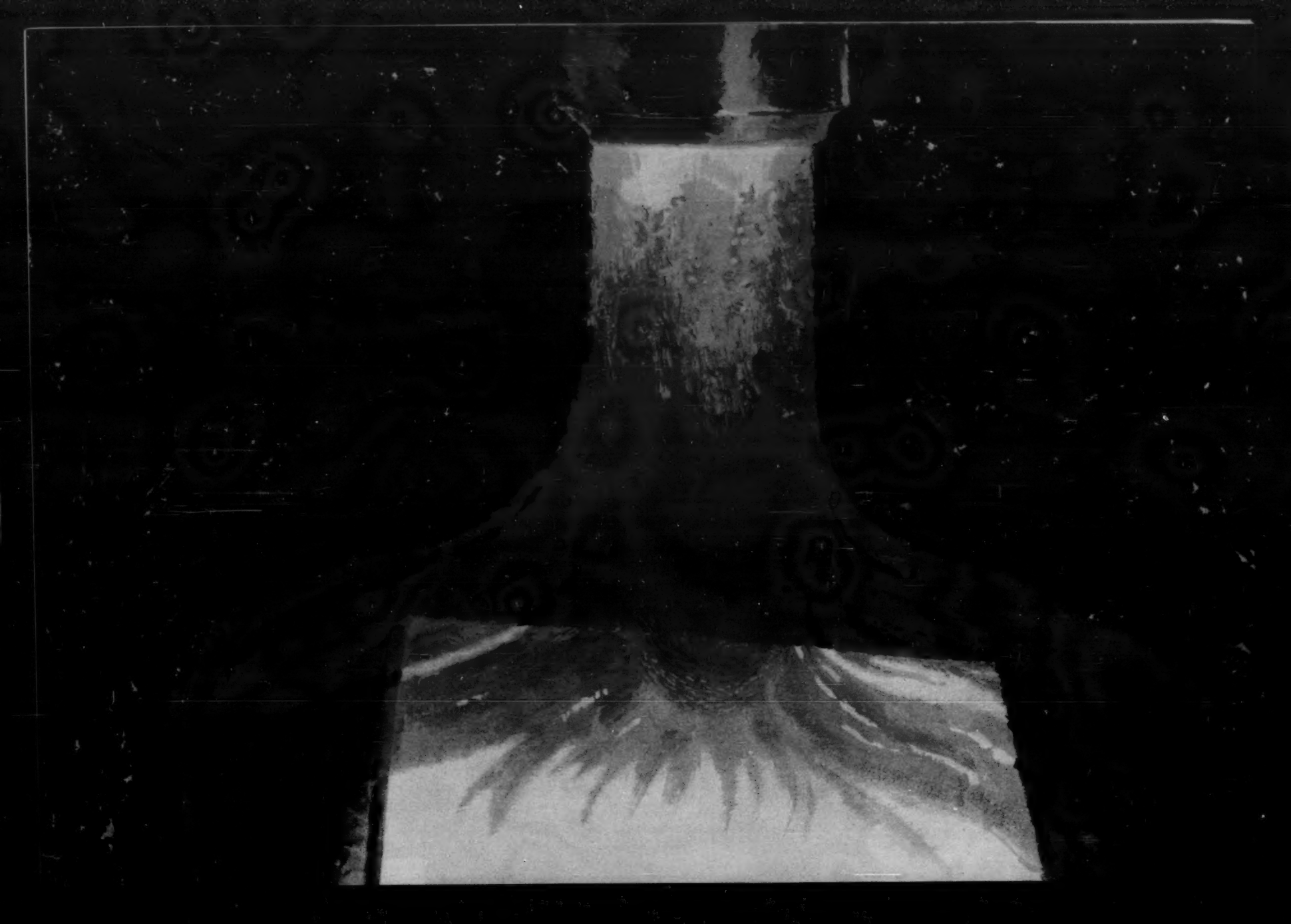
This Crane bronze gate valve has a cylindrical body . . . the best design to withstand internal pressures. Ordinary rectangular body design creates stress concentration at corners, which may result in distortion of the valve body causing leakage or early failure. Huskier, better integrated Crane design has more rigidity under strains, reinforces seats against wedging action of disc.

No. 424; 200 Pound
No. 634; 300 Pound

CRANE®

Crane Co., Industrial Products Group, 4100 S. Kedzie Ave., Chicago 32, Ill.

VALVES • ELECTRONIC CONTROLS • PIPING • PLUMBING • HEATING • AIR CONDITIONING





# OUT OF FLUIDICS COMES A NEW MATERIAL

# PFAUDLER NUCERITE*

**Here's a material of construction that copes with high temperature, impact, and corrosion.**

What processes, heretofore held back for lack of a proper material, will you explore first with Nucerite?

For example, if corrosion at high temperatures is a problem, Pfaudler® Nucerite could be the answer, since it resists corrosive vapors at temperatures that would destroy most metals in minutes.

If high-temperature stability is what you're looking for, consider that Nucerite can protect a base metal from oxidation at 2000° F.

Impact strength? Only a minor surface crush is what you get on Nucerite with a point-of-impact force eighteen times greater than what's needed to shatter safety glass. Thermal shock? Nucerite can take an instantaneous temperature differential of 1200° F.

**WHAT IT IS.** Nucerite is properly classified as a family of ceramic-metal composites in which a ceramic formulation is physically and chemically bonded to a structural base metal.

**NOT A GLASSED STEEL.** After the ceramic component is applied and fired on, controlled nucleation and crystallization take place during heat-treatment as a result of agents which act as centers of nucleation.

This leads to a ceramic structure with a large number of very small crystals and results in a tough ceramic-metal composite with a unique combination of properties.

Today, Nucerite is a laboratory achievement.

You are invited to make inquiries on possible applications for it and investigate field testing programs. The above lab test data are detailed in Bulletin 999. Use the coupon, or direct your questions to our Pfaudler Division, Dept. CE-110, Rochester 3, New York.

FLUIDICS is the Pfaudler Permutit program that integrates knowledge, equipment and experience in solving problems involving fluids.

*Patent applied for

---

**PFAUDLER PERMUTIT INC.**

A world-wide company with plants in Germany, Great Britain, Canada, Mexico, Japan, as well as the U.S.A.

Pfaudler Division, Dept. CE-110, Rochester 3, New York.

Please send Bulletin 999 on NUCERITE, Pfaudler's new ceramic-metal composite.

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COMPANY.....

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CITY..... ZONE..... STATE.....




Typical control panel at Union Carbide's Institute Plant has over 100 Foxboro Consotrol* indicators, recorders, and controllers.

# for Union Carbide's Institute Plant...rapid,

A sprawling chemical metropolis, stretching as far as the eye can see. That's Union Carbide Chemicals Company's Institute, West Virginia plant — producer of Ucon† Fluorocarbon propellants and refrigerants.

Foxboro instrumentation is used to help control 20 of the different processing units at the Institute Plant. Over 10,000 Foxboro indicators, controllers, recorders, and transmitters are used, as well as thousands of Foxboro control valves.

Union Carbide reports favorably on their Foxboro instruments. "In general, we find them easy to work on, easy to repair, easy to maintain." And the company adds, "we appreciate the ability of the Foxboro engineers who work with us."

*Reg. U. S. Pat. Off.*
*†Trade-mark of Union Carbide Corp.*

Process is hydraulic — requires fast, sensitive instrument response.

# sensitive Foxboro control

You'll like working with Foxboro, too. Unsurpassed instrumentation, both pneumatic and electronic; unsurpassed engineering and service. Ask your local Foxboro Field Engineer for the complete story. Or write for Bulletin 13-18. The Foxboro Company, 3611 Neponset Avenue, Foxboro, Massachusetts.

FOXBORO

REG. U. S. PAT. OFF.



Lab analysis is done right in the control room of this Carbide processing unit. Necessary process adjustments can be made on Foxboro controllers the minute technician detects the need.

# NEW...FROM TUBE

**FROM YOUR TUBE TURNS' DISTRIBUTOR**

The complete line of PIPE-MATE Fittings, Flanges and Accessories are available from your nearby Tube Turns' Distributor. For pipe sizes ½" to 4"... Schedules 5S and 10S... in Types 304L, 316 and 316L.



# TURNS...

## PIPE-MATE light-wall stainless steel fittings and flanges

Tube Turns introduces another important key to lower piping costs... a new line of light-wall stainless steel fittings and flanges for process piping. Here's how this PIPE-MATE* line reduces costs...

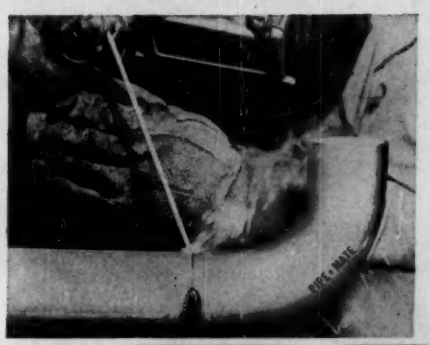
**Cuts material costs.** Compared to standard weight Schedule 40S pipe, *light-wall* piping in Schedule 5S or 10S cuts material costs as much as 30% to 50%. It weighs ½ to ⅓ as much, is easier to handle, easier to install and provides greater flow area.

**Simplifies installation.** Extra long tangents of PIPE-MATE fittings provide full straight-line clearance for fitting-to-fitting connections and permit fabrication of completely flanged elbows, returns, tees, etc. Aligning connector speeds making of socket type joints. Fittings may be butt-welded, fillet-welded, brazed or soldered, or joined by rolled-in flange connections.

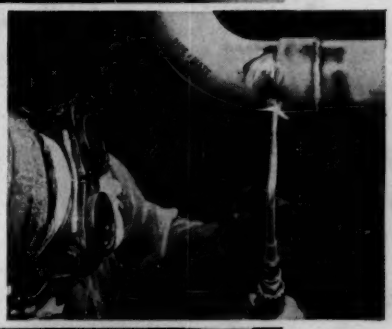
Here is another plus value you get when you specify products of Tube Turns and buy them from your Tube Turns' Distributor.

**FREE BULLETIN on PIPE-MATE** Fittings and Flanges describes complete line, shows installation procedures, and gives properties and dimensional tolerances. Mail coupon for copy.

*"PIPE-MATE" and "tt" are trademarks of Tube Turns.

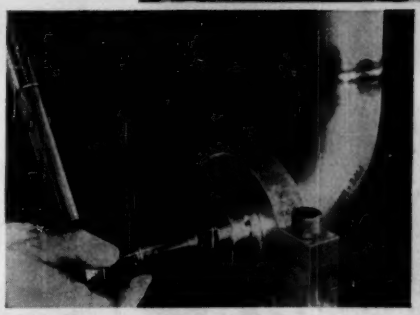



FOR BUTT-WELDING



FOR FILLET-WELDING, BRAZING OR SOLDERING

FOR ROLLED-IN FLANGED JOINTS



*Another* tt *plus value from...*

**TUBE TURNS**

**DIVISION OF CHEMETRON CORPORATION**

**Louisville 1, Kentucky**

CHEMETRON

DISTRICT OFFICES: Atlanta • Buffalo • Chicago • Columbus • Dallas Denver • Detroit • Houston • Kansas City • Los Angeles • New York Philadelphia • Pittsburgh • Richmond • St. Petersburg • San Francisco • Seattle Shreveport • Tulsa

*In Canada:* TUBE TURNS OF CANADA LIMITED, Ridgetown, Ontario
*District Offices:* Edmonton • Montreal • Toronto

*In Mexico:* TUBE TURNS DE MEXICO, Mexico City

**TUBE TURNS**
**Department CE-11, 224 East Broadway**
**Louisville 1, Kentucky**

Please send bulletin TT944AR.

*Company Name* _____

*Company Address* _____

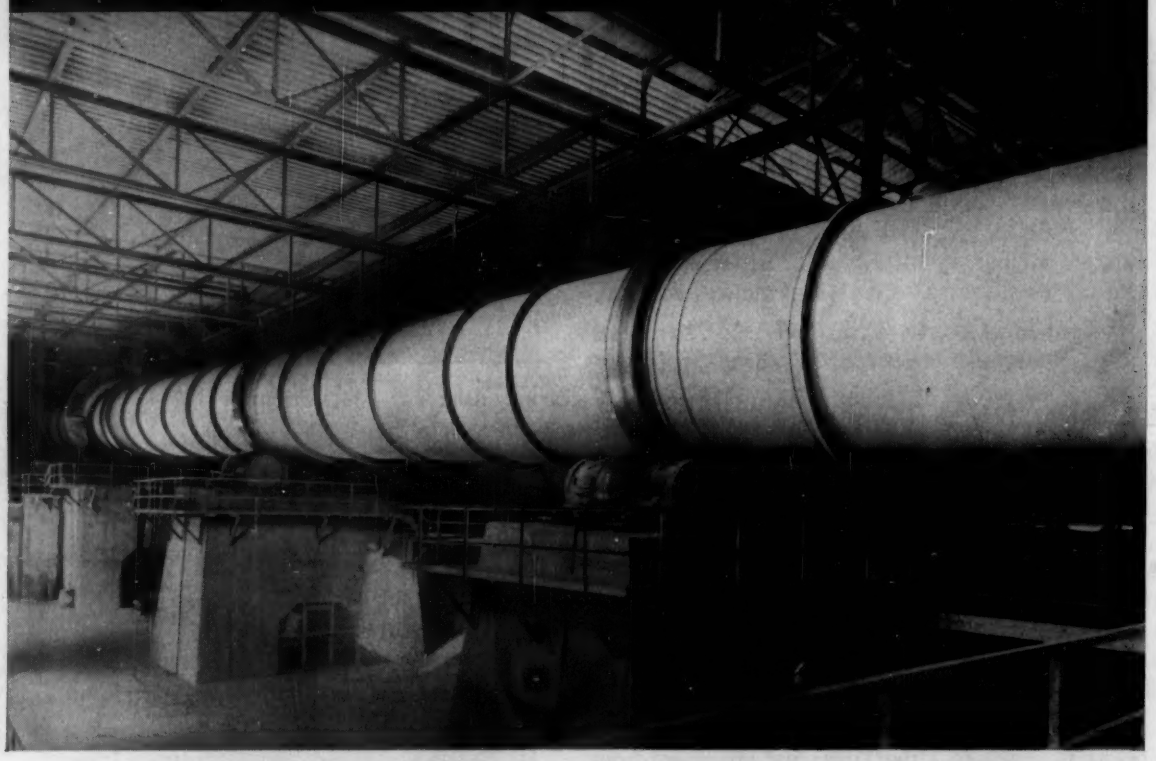
*City* _____ *Zone* ____ *State* ____

*Your Name* _____

*Position* _____

# TRAYLOR-PIONEERED AND TRAYLOR-PERFECTED

## *efficiency built into this rotary kiln*



Traylor engineers were called on to design this modern 450′ kiln for Canada Cement Co. This kiln features many Traylor pioneered developments which decrease down time and increase production. It has full-thrust roller mechanism and roller supports tied together so that a rigid mounting is obtained insuring better kiln operation. The riding ring is mounted on machined steel pads which hold the ring securely in place but allow full-floating action, continuous operation and low maintenance.

Write outlining your kiln requirements for recommendations by Traylor engineers . . . and for Bulletin No. 1115.

This kiln at the Canada Cement Company in Montreal is 12′ x 450′. Seven roller supports keep its 450 foot length in steady easy alignment.

**TRAYLOR ENGINEERING & MANUFACTURING**
DIVISION OF FULLER COMPANY
1551 MILL ST., ALLENTOWN, PA.

Sales Offices: New York — Chicago — San Francisco
Canadian Mfr.: Canadian Vickers, Ltd., Montreal, P. Q.

TEA-11



## A BUFFALO RESIN-BONDED FIBER GLASS FAN MAY BE YOUR ECONOMICAL ANSWER

Excellent chemical resistance to a wide range of acids, salts, gases, organic materials and other corrosives — strength and resilience — ability to stand temperatures up to 300°F. with special resins — and light weight are some of the desirable characteristics of the 'Buffalo' Type FG Fan.

**FLANGED INLET AND OUTLET**—for gas-tight connections.

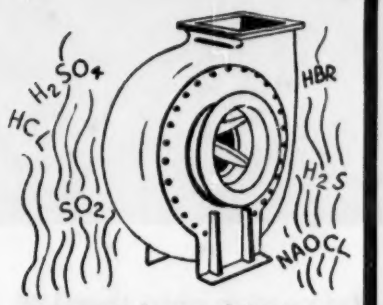
**CAPACITIES** — up to 34,000 cfm.

**PRESSURES** — up to 10″ static.

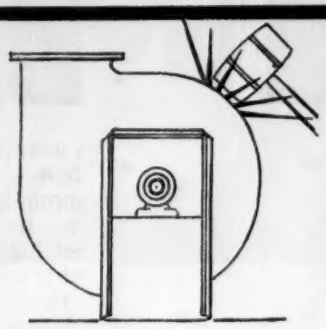
**Fan Housing** — resin-bonded fiber glass with stainless steel studs moulded-in for mounting to the bearing stand flange. Efficient scroll shape.

**Rotor** — husky steel wheel completely encased in resin-bonded fiber glass. Factory-balanced, statically and dynamically, for vibrationless performance.

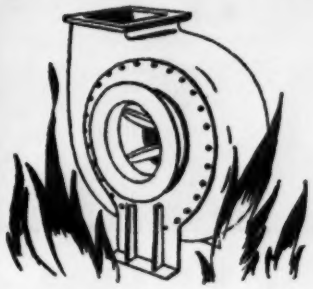
# FUME-HANDLING PROBLEM?




corrosion-resistant



impact-resistant



won't support combustion

**WRITE FOR BULLETIN FI-511** for all details and chemical resistance table.

**BUFFALO FORGE COMPANY**

Buffalo, New York

Canadian Blower & Forge Co., Ltd., Kitchener, Ont.



*Buffalo air handling equipment to move, heat, cool, dehumidify and clean air and other gases.*



*Buffalo Machine Tools to drill, punch, shear, bend, slit, notch and cope for production or plant maintenance.*



*Buffalo Centrifugal Pumps to handle most liquids and slurries under a variety of conditions.*



*Squier machinery to process sugar cane, coffee and rice. Special processing machinery for chemicals.*



**So Long... Until Tomorrow** It took five flat cars to ship this 195 foot-long fractionating column from our Orange, Texas, plant. Even the Texans thought it was a whopper, but tomorrow we'll be fabricating bigger ones—that's the way it goes. ☐ This column went to a leading refinery where it produces high purity isobutane, a component of premium gasoline. ☐ The 12-foot diameter steel column is made up of 20 rings or sections, each ¾ of an inch thick. The rings are welded together, then welded to a 20-foot skirt which supports the tower in its upright position. After fabrication the column was stress relieved.




Our Orange, Texas plate shop can handle custom plate work of all kinds and sizes. We have experienced men and the right equipment, high capacity cranes, giant presses and bending rolls, the latest welding equipment, mammoth car bottom furnaces, and complete inspection facilities. We can ship by rail, truck or barge. And anything we make, we can erect. ☐ Write for our booklet on plate fabricating facilities and services.

*USS is a registered trademark*

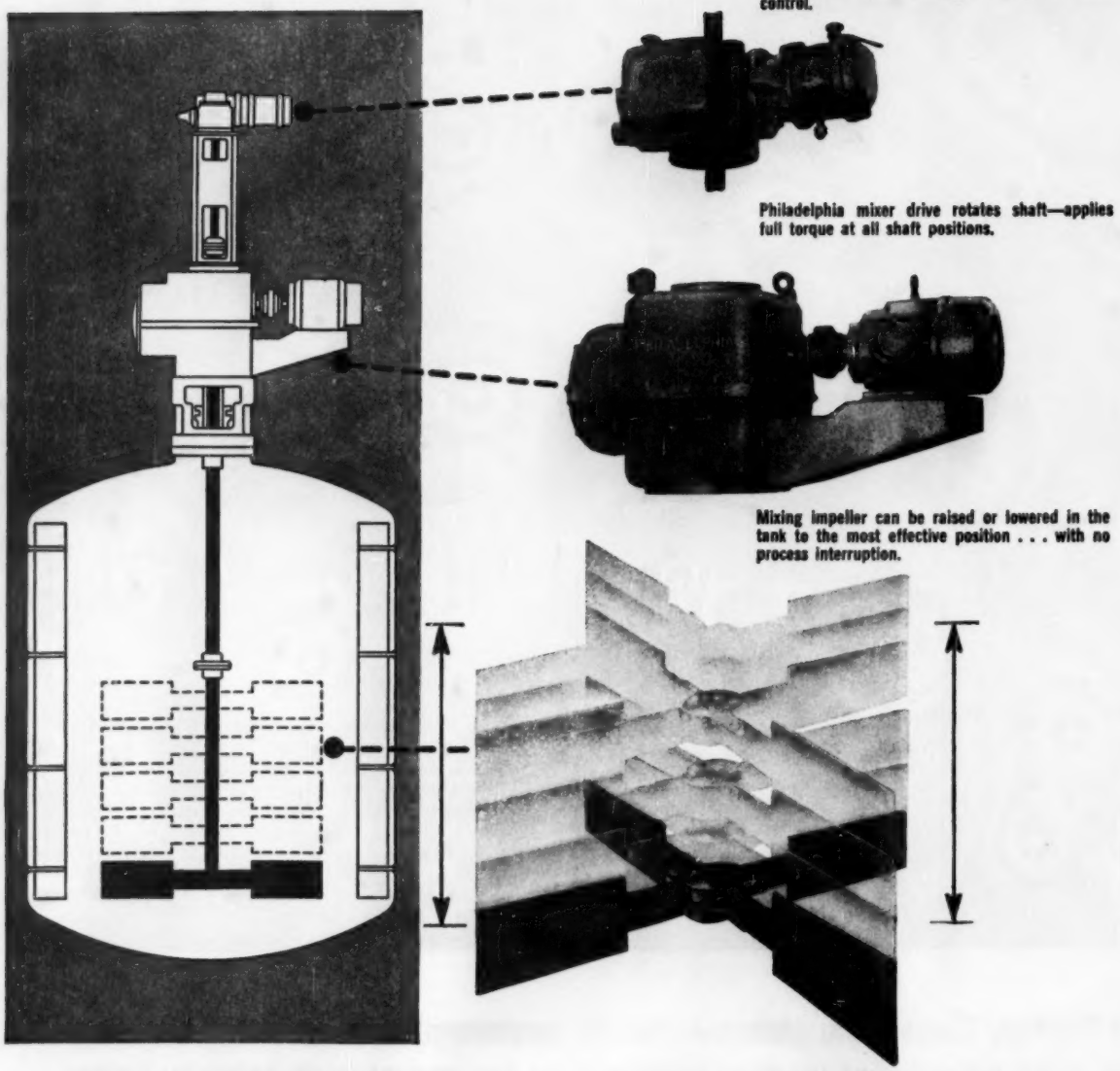
This mark tells you a product is made of modern, dependable Steel.

General Offices: 525 William Penn Place, Pittsburgh, Pa.
Contracting Offices in: Ambridge • Atlanta • Baltimore • Birmingham Boston • Chicago • Cincinnati • Cleveland • Dallas • Denver • Detroit Elmira • Gary • Harrisburg, Pa. • Houston • Los Angeles • Memphis Minneapolis • New York • Orange, Texas • Philadelphia • Pittsburgh Portland, Ore. • Roanoke • St. Louis • San Francisco • Trenton United States Steel Export Company, New York

**American Bridge Division of United States Steel**

USS

# NOW...you can raise and lower mixing impellers with no process interruption...



Philadelphia Limitorque raises and lowers mixer shaft—either automatically or by push button control.

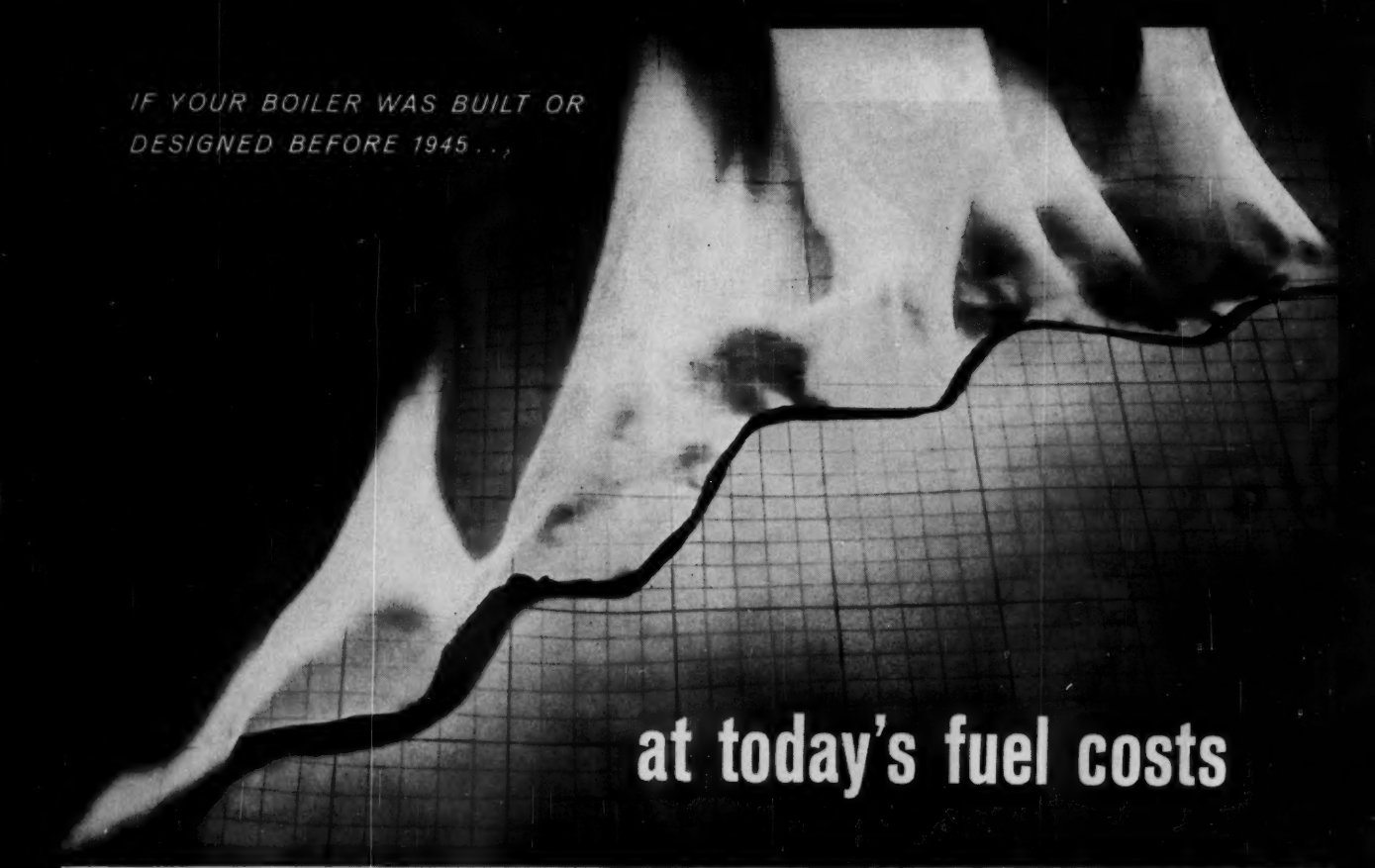
Philadelphia mixer drive rotates shaft—applies full torque at all shaft positions.

Mixing impeller can be raised or lowered in the tank to the most effective position . . . with no process interruption.

This combination of Philadelphia Mixer power transmission components gives you optimum mixer performance at all times. Mixing can continue at full tank pressure while impeller position is changed, and there is no danger of product contamination because it can be done without opening the tank.

Many processors are already taking advantage of this unusual mixer design feature. Why not learn how Philadelphia lifting-lowering mixers can improve the effectiveness of your mixing operations. For full information, send for Bulletin LL-60.

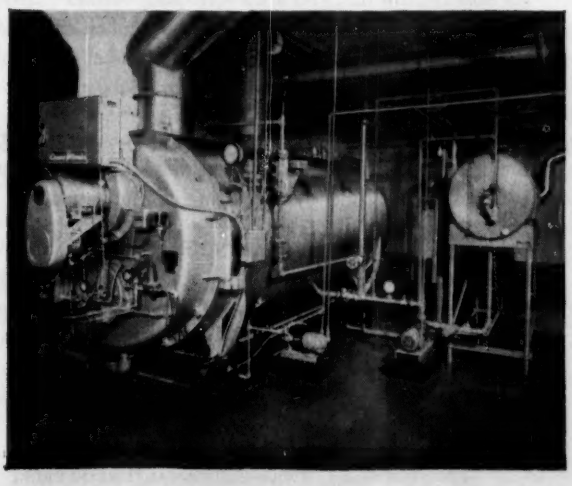
**philadelphia mixers** | PHILADELPHIA GEAR CORPORATION
King of Prussia (Suburban Philadelphia), Penna.




# you may be paying for it a second time!

**GETTING MORE HEAT FOR THE FUEL DOLLAR**

The W. T. Rawleigh Company, manufacturer of toiletries, medicines and food products for the home and farm, replaced two old firebox boilers in their Memphis, Tennessee, branch with one fully automatic, combination-fired CB boiler. Mr. James Trindle, office manager, reports: "Our records show . . . 36.4% less fuel consumed during winter months that averaged about 12% colder than the previous year. We're getting greater fuel economy than we expected."



Are you operating a boiler that was designed in the day when fuel costs were much lower? Just since World War II, fuel prices have soared. And these higher costs put a premium on "little" inefficiencies that might have been ignored when your boiler was built.

Conversion is not the answer. You cannot buy efficiency in a boiler designed for solid fuels simply by switching to a conversion-type oil or gas burner. The answer is a *truly* packaged Cleaver-Brooks boiler — with all components designed to work together — fully factory-assembled and fire-tested.

To further provide and maintain top efficiency, modern Cleaver-Brooks packaged boilers offer a combination of fuel-saving design standards that cannot be found in any other boiler — at any price.

This combination of features — *four-pass design, forced-draft combustion, updraft construction and all the advantages of five square feet of heat-transfer surface per boiler horsepower* — puts your fuel costs down where they belong.

All this is provided by Cleaver-Brooks in the most compact, automatic packaged unit on the market. Sizes through 600 hp . . . oil, gas and combination oil-gas firing . . . larger sizes in Cleaver-Brooks Springfield water-tube boilers. *All* models are expertly started for you by a trained field engineer.

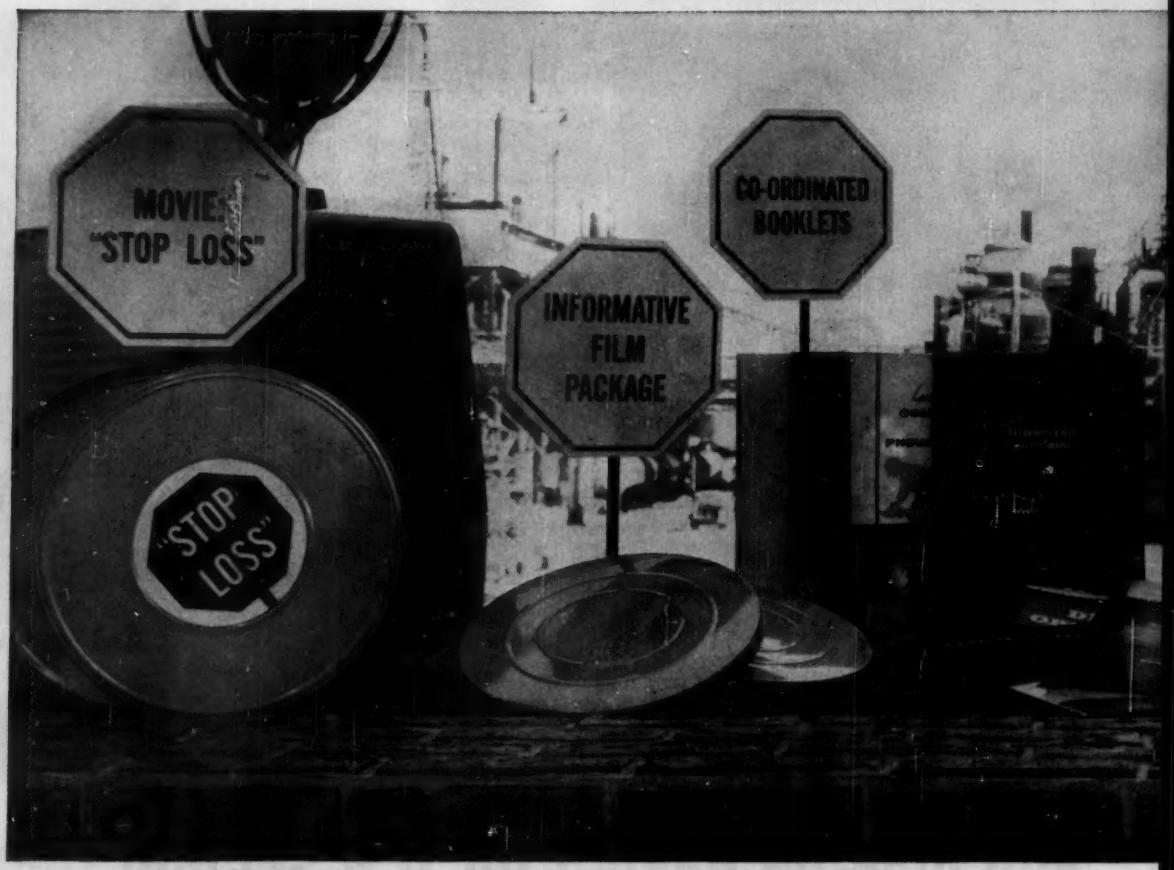
See your local Cleaver-Brooks agent for more detailed information, or write for the booklet, *How to Select a Boiler.*

**Cleaver Brooks®**

ORIGINATOR AND LARGEST PRODUCER OF PACKAGED BOILERS

**CLEAVER-BROOKS COMPANY**

Dept. M, 345 E. Keefe Ave., Milwaukee 12, Wisconsin




**MOVIE: "STOP LOSS WITH ORGANIZED LUBRICATION,"** a new 20-minute color-and-sound film that dramatizes the opportunities for cost control through Organized Lubrication.

**INFORMATIVE FILM PACKAGE** for plant departments consists of movies on greases, hydraulic oils, etc., designed to help those involved with their selection and application.

## HERE ARE THE TOOLS THAT CAN HELP YOU

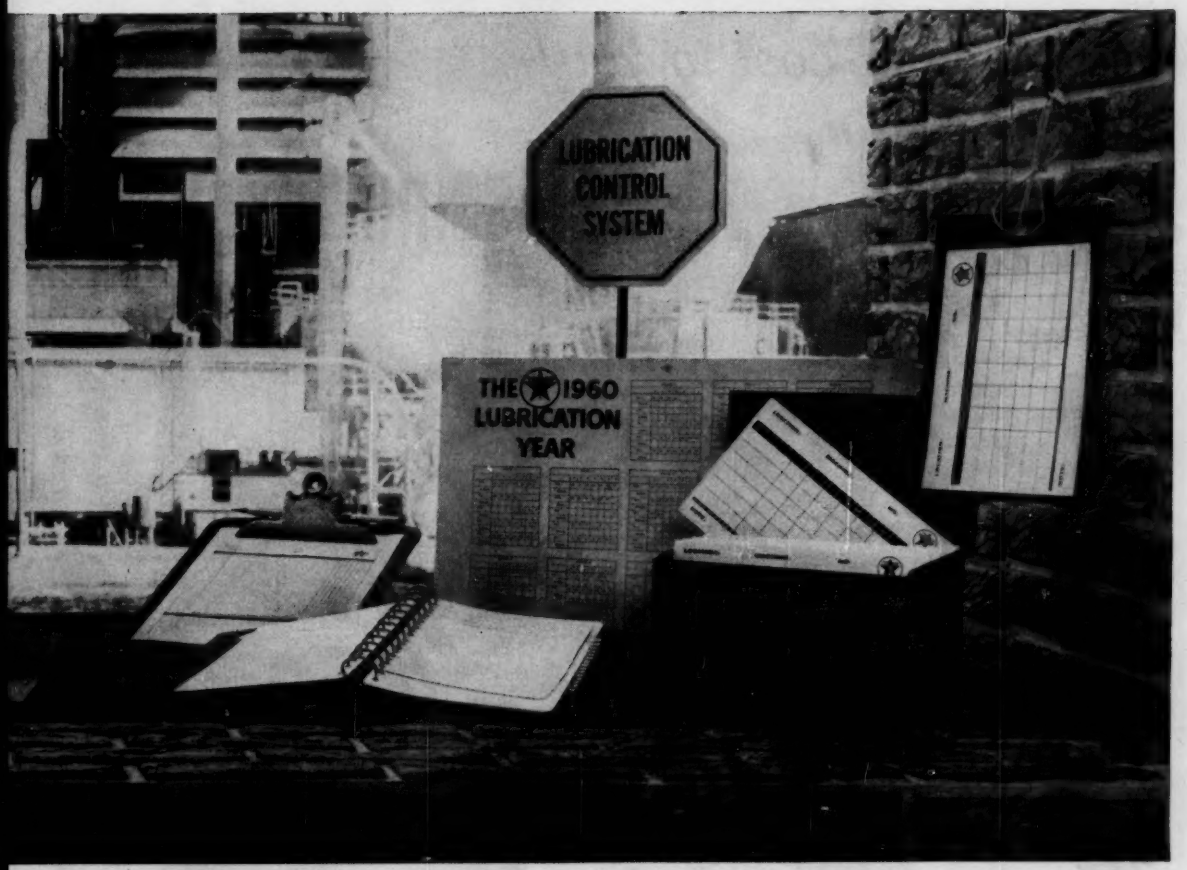
# INCREASE YOUR NET PROFITS

**Texaco's new "Stop Loss" program is designed to cut maintenance costs by modernizing lubrication practices. If yours is an average plant, the results can add 4 per cent to your net profit.**

Even if your chemical processing plant is an efficient operation it is still virtually certain that there is an opportunity for cost control that you are overlooking—either partially or completely. This is in the vital area of lubrication. And nowhere are lubrication practices more critical than in the highly automated chemical processing industry.

The 4 per cent figure is not hypothetical. It's what the Small Business Administration has found the average plant can tack on to profits by organizing its lubrication.

**Texaco's Program is designed to help you.** Texaco has developed a "Stop Loss" Program specifically designed to help you cut maintenance costs via better lubrication practices. It will help you stretch equipment life, minimize downtime, reduce lube inventory, even cut purchasing costs. It costs virtually nothing to install; yet will start turning maintenance savings into profits almost immediately.




**CO-ORDINATED BOOKLETS** covering almost every facet of lubrication can be used as guides in specific areas.

**TEXACO LUBRICATION CONTROL SYSTEM** takes the guesswork out of all lubrication scheduling—makes sure that the right lubricant goes in the right place at the right time.

# BY AS MUCH AS 4 PER CENT!

**Can your plant pass this test?**

**Q.** Is there anyone in your plant with the direct responsibility for all lubrication? Yes ☐ No ☐

**Q.** Is there any plant-wide system for making sure that equipment gets lubricated on schedule? Yes ☐ No ☐

**Q.** Are your oilers qualified men with a knowledge of mechanisms to be lubricated? Yes ☐ No ☐

**Q.** Have you had a lubrication study made to be sure you are using the proper lubricants at the right time? Yes ☐ No ☐

If the answer is "no" to any of the above questions, it is almost certain that a Texaco "Stop Loss" Program can improve your profit picture.

**See for yourself how "Stop Loss" works!** Texaco has just released a new color-and-sound movie to dramatize the benefits of good lubrication practices. It's called "Stop Loss through Organized Lubrication" and we think it would be profitable for you to see it. For an early showing in your plant, mail in the coupon today! Texaco Inc., 135 East 42nd Street, New York 17, N. Y.

***MAKE YOUR RESERVATION TODAY!***

**TEXACO INC., Dept. CE-CP-51**
**135 East 42nd Street**
**New York 17, New York**

I would like to see your new movie "Stop Loss through Organized Lubrication." Please call to arrange a showing.

TEXACO

Name_____ Title_____

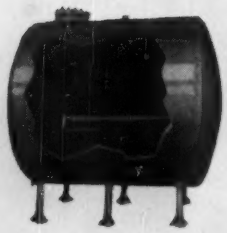
Firm_____

Address_____

City_____ Zone____ State_____

*No added cost to you!*

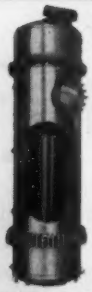
# "Special" 778 glass now standard



STORAGE TANKS



HEAT EXCHANGER TUBES

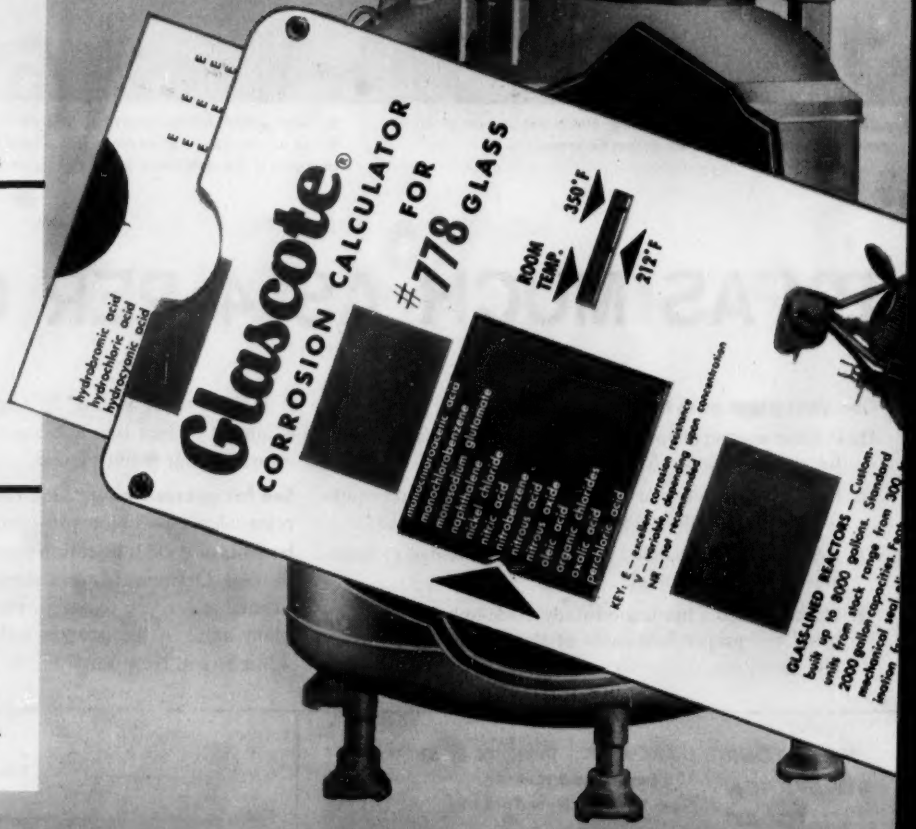


COLUMNS



DRYER-BLENDERS

REACTORS



# on all Glascote® process equipment

When we introduced Glascote 778 glass we knew many processors would want it — but we didn't expect a **landslide!** Today so many of our customers specify this remarkably acid-resistant glass that we've made it **standard** on all Glascote reactors, columns, storage tanks, rotary dryer-blenders, pipe and fittings.

This means that, at no extra cost, you will get a unique glass lining that extends acid resistance up to 75°F higher operating temperature **with no sacrifice in its ability to resist alkali and thermal shock!**

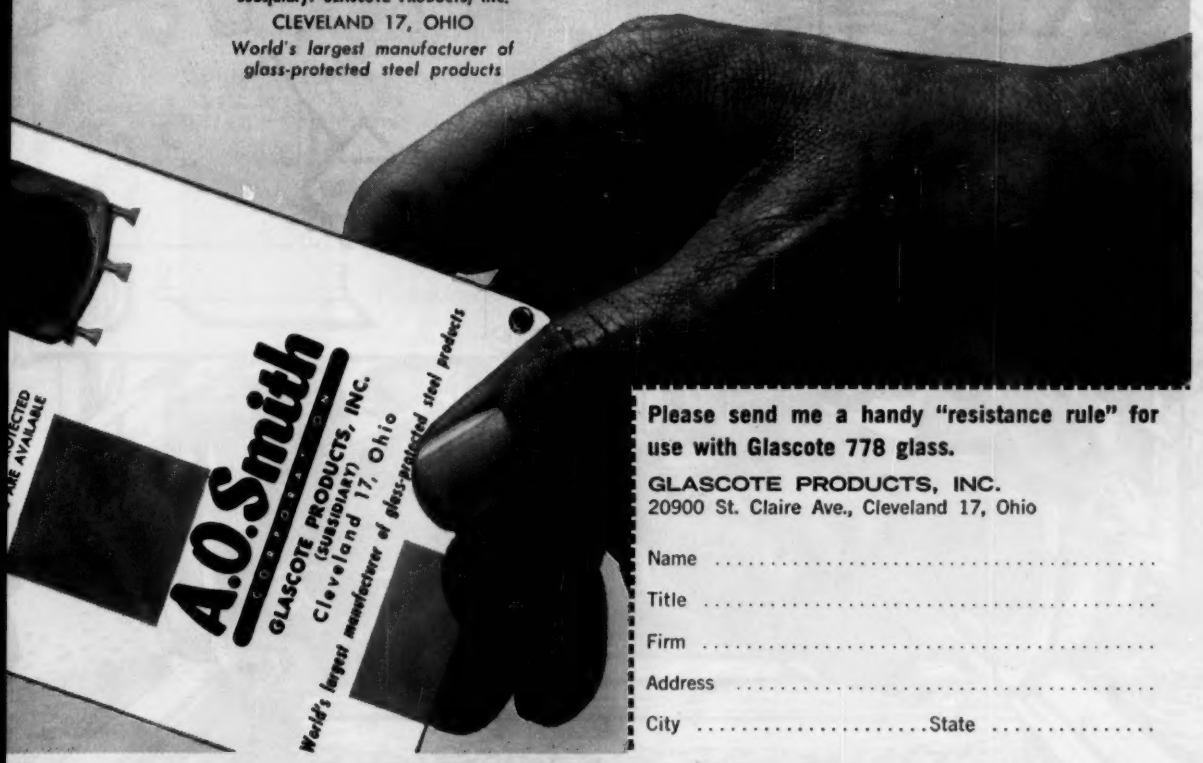
For your convenience we have prepared a "resistance rule" (pictured at left). It lists 150 hard-to-handle substances from acetaldehyde to zinc sulfate, and shows at a glance the ability of Glascote 778 to resist their corrosive attacks.

Nevertheless, despite the overwhelming popularity of 778 glass lining, you should keep in mind that this is just one of 3,000 formulations. Some may be even better for your special requirements. Ask the Glascote representative who calls on you.

*Through research* ... *a better way*

**A.O.Smith**
CORPORATION

**Subsidiary: GLASCOTE PRODUCTS, INC.**
CLEVELAND 17, OHIO
*World's largest manufacturer of glass-protected steel products*




**Please send me a handy "resistance rule" for use with Glascote 778 glass.**

GLASCOTE PRODUCTS, INC.
20900 St. Claire Ave., Cleveland 17, Ohio

Name .....
Title .....
Firm .....
Address .....
City .....State .....


GATX 16527
DANGEROUS

# The vital chemical reaction . . . customer confidence

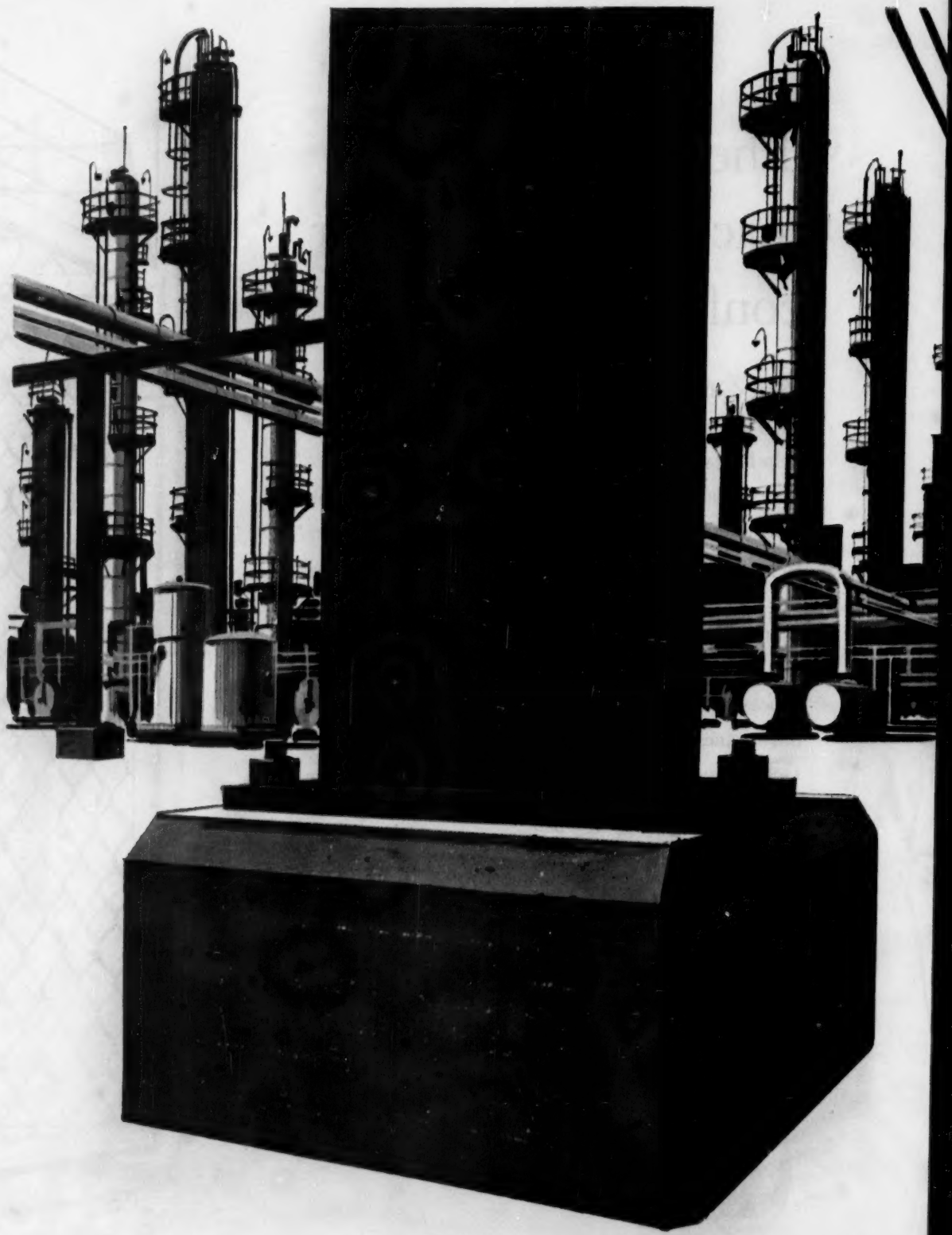
Order delivered. Responsibility ended? Not as we see it. If a customer has a caustic storage problem, we help him work it out. If his employees need instruction in the proper handling of chlorine, we offer this instruction. For, to us the business of a chlorine-caustic producer is by nature part science, part service. This explains much of what we do. It is why, though we are producers of raw-material chemicals, we duplicate in our laboratories the manufacturing processes that involve them. It is why we make it our business to understand yours as fully as possible. Going beyond our required responsibilities whenever we can be of help is a fixed habit at Wyandotte, and it has earned for us that vital chemical reaction . . . the confidence of our customers. May we serve you? *Wyandotte Chemicals Corporation, Wyandotte, Michigan. Offices in principal cities.*



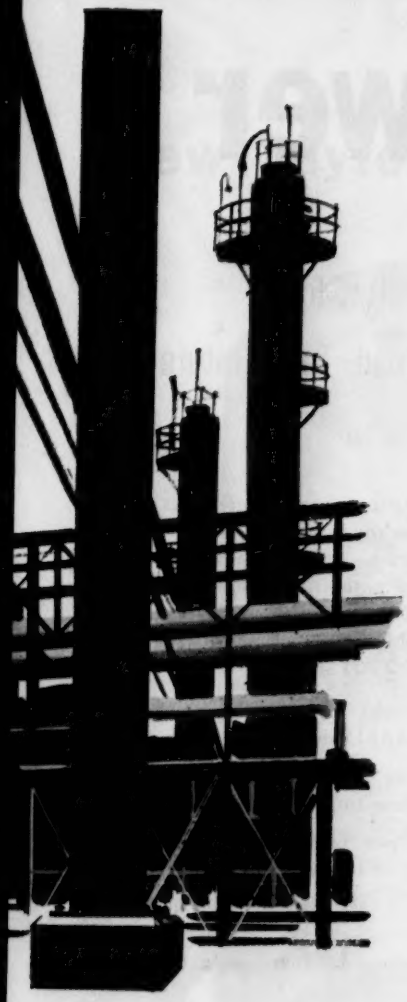
**WYANDOTTE CHEMICALS**

**MICHIGAN ALKALI DIVISION**

*Pacing progress with creative chemistry*



**Foster Wheeler *Heat Engineered* products, plants and processes . . . for the world's industrial progress**



# Best foundation for process profitability

What is the best insurance that your new process plant will produce "as planned"?

When Foster Wheeler is your "planner" there is experience with the design, construction and start-up of 75 different processes—in more than 800 plants throughout the world—to provide a sound basis for every detail.

This experience covers every conceivable operating condition: temperatures, pressures, corrosion, erosion and others. The problems of equipment design and world-wide procurement have been met and solved, over and over again.

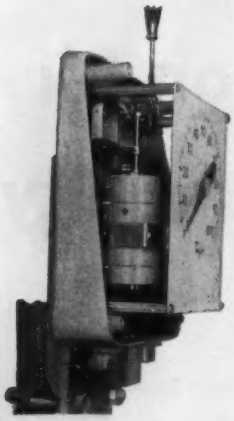
When Foster Wheeler designs, engineers and constructs your process plant, *experience* is the foundation for process profitability.

**FOSTER WHEELER**

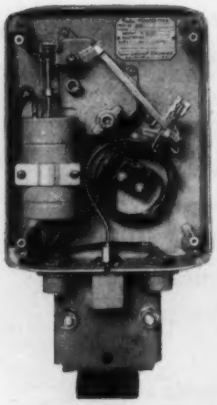
NEW YORK LONDON PARIS ST. CATHARINES, ONT.

# Now... Servo Power in

## A high-accuracy, low-cost, motion-balance transmitter for Gage Pressure, Volumetric Pressure, Volumetric Load, Temperature



Diagonally-split case permits calibration adjustments to be made without removing dial.



Single-package pneumatics . . . servo-powered follow-up and relay valve, encapsulated movement and actuating element are easily removable, replaceable.

Taylor's new integrated line of pneumatic transmitters features servo-driven indication as an option on the indicating model. This provides ample power for process alarms—and other auxiliary functions such as digital encoders and potentiometers—with no loss of accuracy in the transmitted signal. Not only does it satisfy today's requirements . . . it provides for possible future needs. Other important features of the TRANSCOPE **210T** include:

- **High accuracy.** Transmitted signal is within ½% of the input signal. Indication is within ±1% of actual value.
- **Exceptional readability.** Big 11¾" long concentric 270° scale can be read easily at 25-35 ft. Yet case measures only 7" x 9" x 4".
- **Threshold sensitivity.** 0.1% of input span. Low-friction drive mechanism permits accurate handling of low-energy input signals.
- **Designed for easy maintenance.** Only 3 basic parts. A high quality encapsulated motion amplifier; single-packaged pneumatics . . . servo-powered follow-up and relay valve; interchangeable, time-tested actuating elements.
- **Lower inventories.** Benefits large users of instruments by utilizing actuating elements which are common with FULSCOPE® and other Taylor indicating, recording and controlling instruments.
- **Conveniently calibrated.** Diagonally-split case makes all adjustments easily accessible by merely removing cover.
- **Weatherproof case.** Special baked epoxy resin finish on die-cast aluminum case . . . designed for field installation.
- **Adaptable mounting.** Universal bracket permits wall or pipe installation.
- **Non-indicating model (211T)** has same performance as 210T except for process indication.

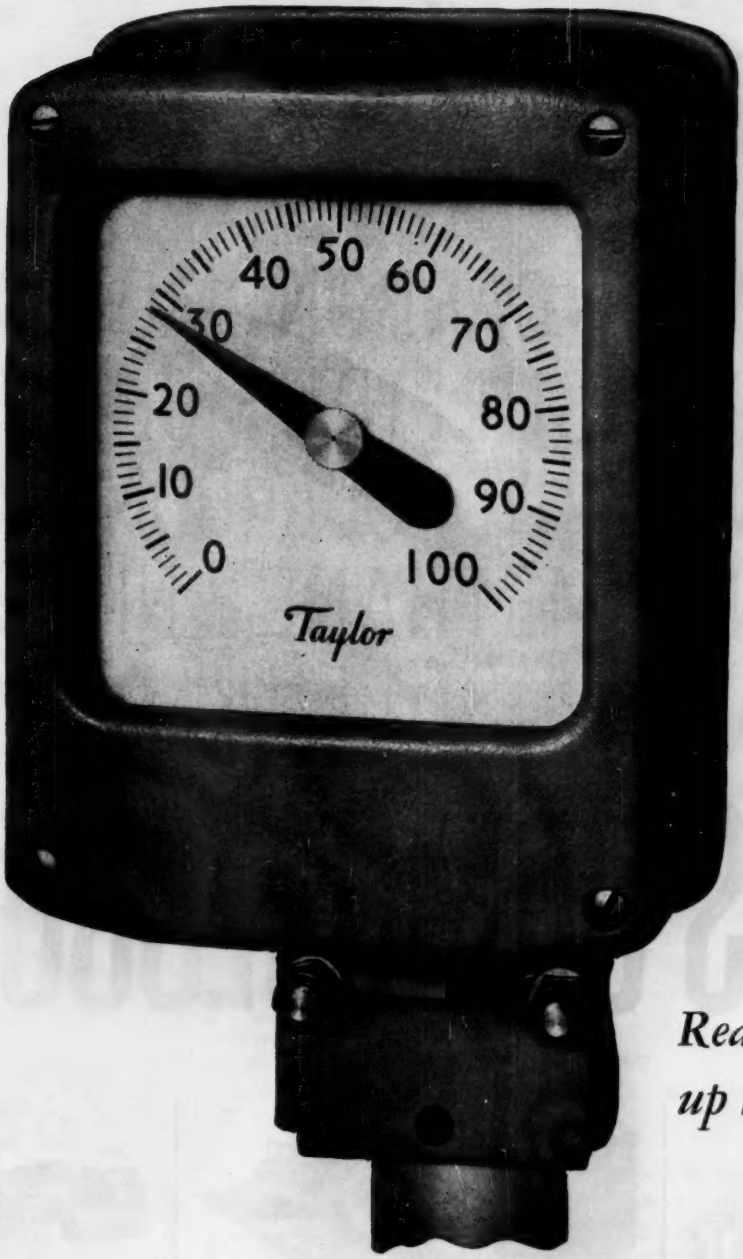
*Ask your Taylor Field Engineer for a demonstration, or write for*

**Bulletin 98385**

*Taylor Instrument Companies, Rochester, N.Y., or Toronto, Ont.*

*Taylor Instruments*

# New Taylor TRANSCOPE® Transmitter




*Read it up to 35 ft.!*

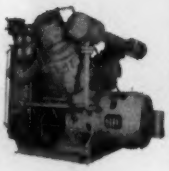
## MEAN ACCURACY FIRST

AMMONIA · CARBON MONOXIDE
HYDROGEN SULFIDE · CHLORINE
HELIUM · HYDROCARBON GASES
BUTANE · METHANE · NITROGEN
PROPANE · SULFUR DIOXIDE

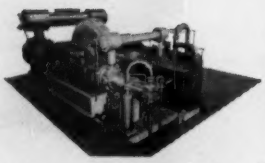
# GAS COMPRESSORS



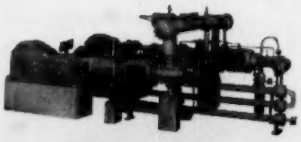
Class "T" (Straight-line Tandem)



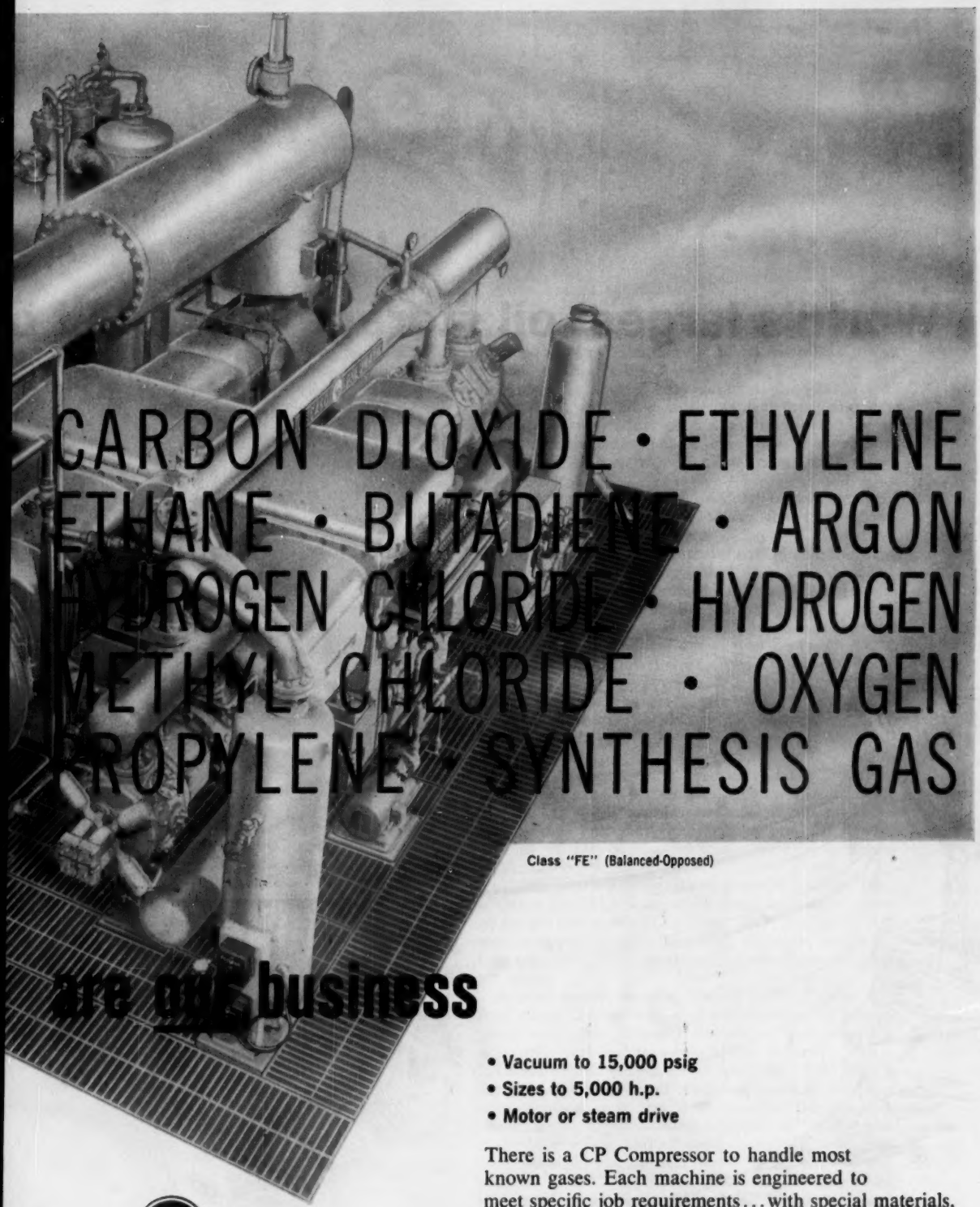
Class "Y"



Class "H" (Four-corner)



Class "O" (Horizontal Duplex)




Class "FE" (Balanced-Opposed)

## are our business

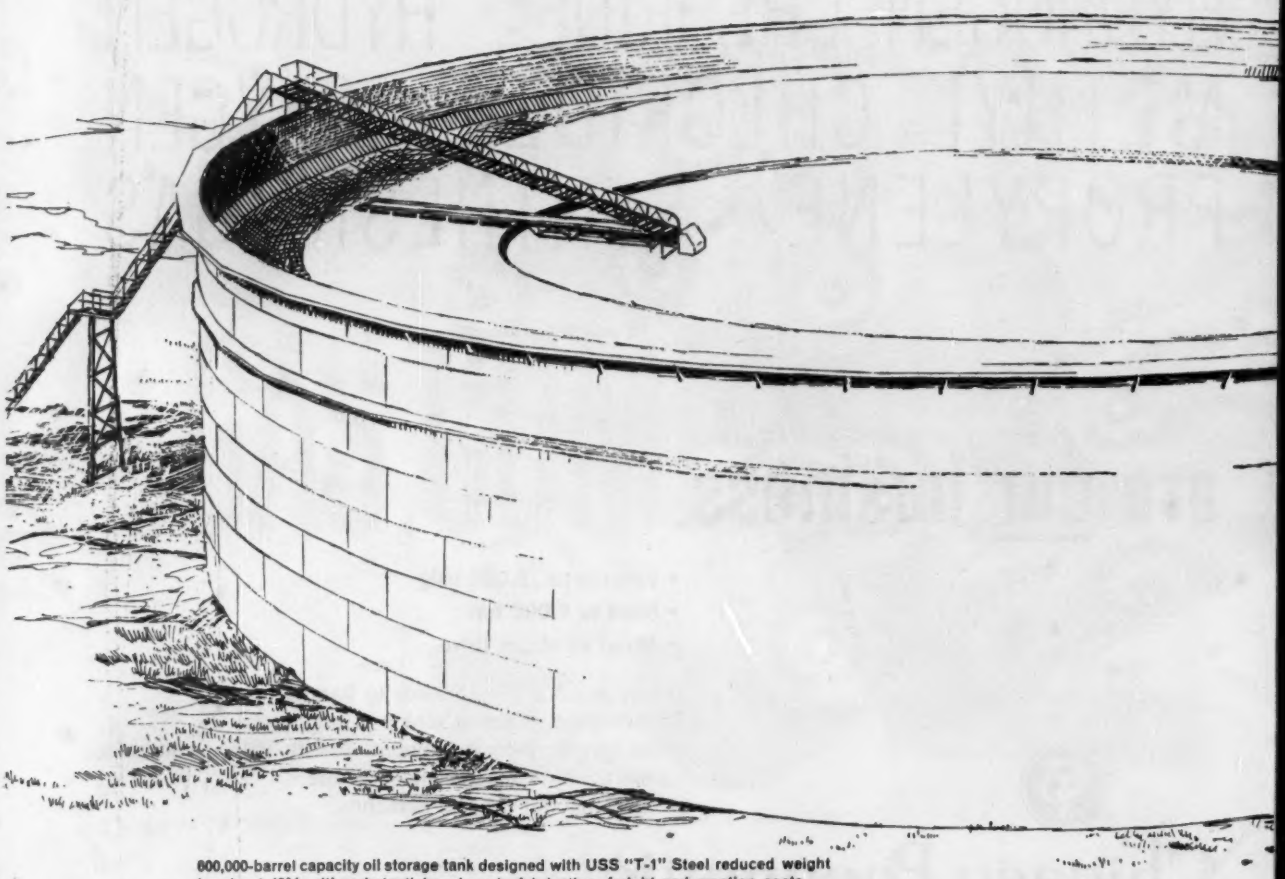
- Vacuum to 15,000 psig
- Sizes to 5,000 h.p.
- Motor or steam drive

There is a CP Compressor to handle most known gases. Each machine is engineered to meet specific job requirements... with special materials, construction, capacity and pressure controls to suit process demands.

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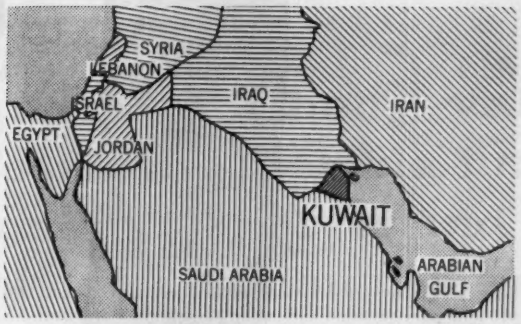
# World's largest oil storage tank built o



600,000-barrel capacity oil storage tank designed with USS "T-1" Steel reduced weight by about 42%, with substantial savings in fabrication, freight and erection costs.

This mark tells you a product is made of modern, dependable Steel.

# "T-1" Steel

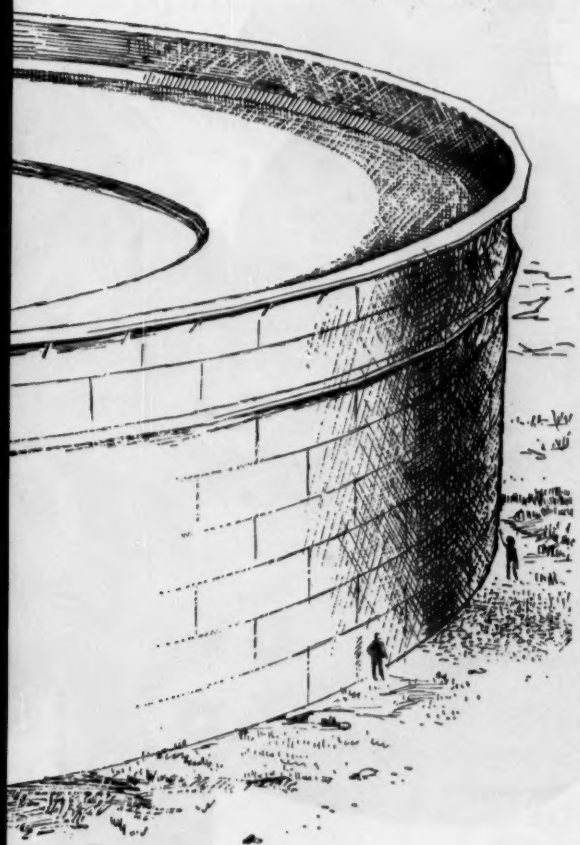



A new 600,000-barrel oil tank 260 feet in diameter and 64 feet high has been erected for the American Independent Oil Company in Mena Abdulla, Kuwait, on the Arabian Gulf.

Kuwait is a petroleum paradise. In 1957, its oil production amounted to 56,000,000 tons, and it is still increasing. Most of the oil is exported and a giant storage tank such as this makes it possible to fill one of the new super tankers in one stop, rather than several.

The Chicago Bridge & Iron Company obtained the contract for the tank with a design that took advantage of the *extra* high strength of USS "T-1" Constructional Alloy Steel and its many cost-saving features.

The shell consists of six 8-foot rings of "T-1" Steel, made to 115,000 psi minimum ultimate strength, and two top 8-foot rings made of A 131 grade A carbon steel. The tank has a Horton pontoon floating roof and the bottom of the vessel was made of A 283 grade C plates ¼-inch thick.



**USS "T-1" Steel reduces weight.** The "T-1" shell thicknesses, which ranged from 1 inch down to ½ inch, were determined on the basis of a design stress of 38,333 psi. This is ⅕ of the minimum ultimate strength of the steel. Joint efficiency was calculated at 100%, with a product specific gravity of 0.90. The top two carbon steel rings were figured for the API 12-C allowable stress of 21,000 psi, with 100% joint efficiency, and with a product specific gravity of 1.0. Steel thicknesses were ½ inch and ⅜ inch.

Although API prohibits the use of carbon steel plates in the thicknesses that would have been needed for the 6 lower rings, by using USS "T-1", 42% less steel was required. Fabricating, shipping, and erecting costs were thus considerably lower than original estimates.

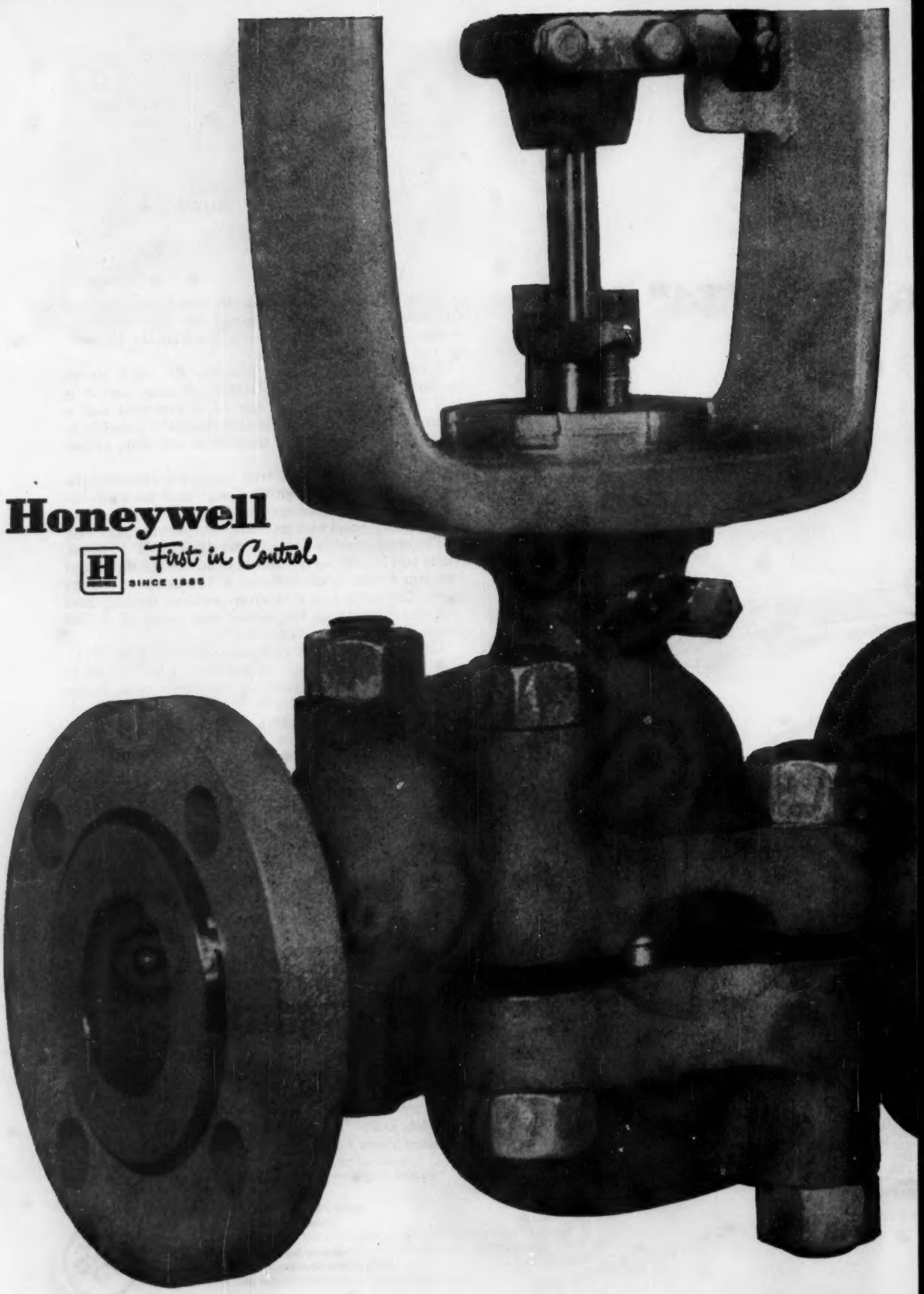
**Lower maintenance, too!** USS "T-1" Steel has four times the resistance of carbon steel to atmospheric corrosion. Research has shown that paint life is greatly increased on steels of this nature.

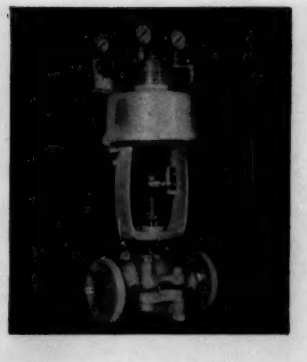
**Other applications.** Because of USS "T-1" Steel's exceptional strength and toughness, even at very low temperatures, it is the ideal material for pressure vessels, equipment hauling trailers, LP gas transports, offshore rigs and other equipment that must be built stronger but lighter. Write for a copy of our booklet, USS "T-1" Steel. United States Steel, 525 William Penn Place, Pittsburgh 30, Pennsylvania.

*USS and "T-1" are registered trademarks of United States Steel*
*"Horton" is a registered trademark of Chicago Bridge & Iron Company*

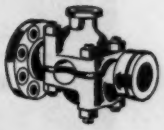
United States Steel Corporation—Pittsburgh
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**United States Steel**


Honeywell
First in Control
SINCE 1885



**Now, a new split-body valve makes possible a flexible intermix of Honeywell valves and actuators—a combination designed for both economy and perfect matching of valve to application. For example,**



**you can get the split-body valve with cost-cutting, clamped-in seat rings, separable flanges and the new cylinder actuator.**



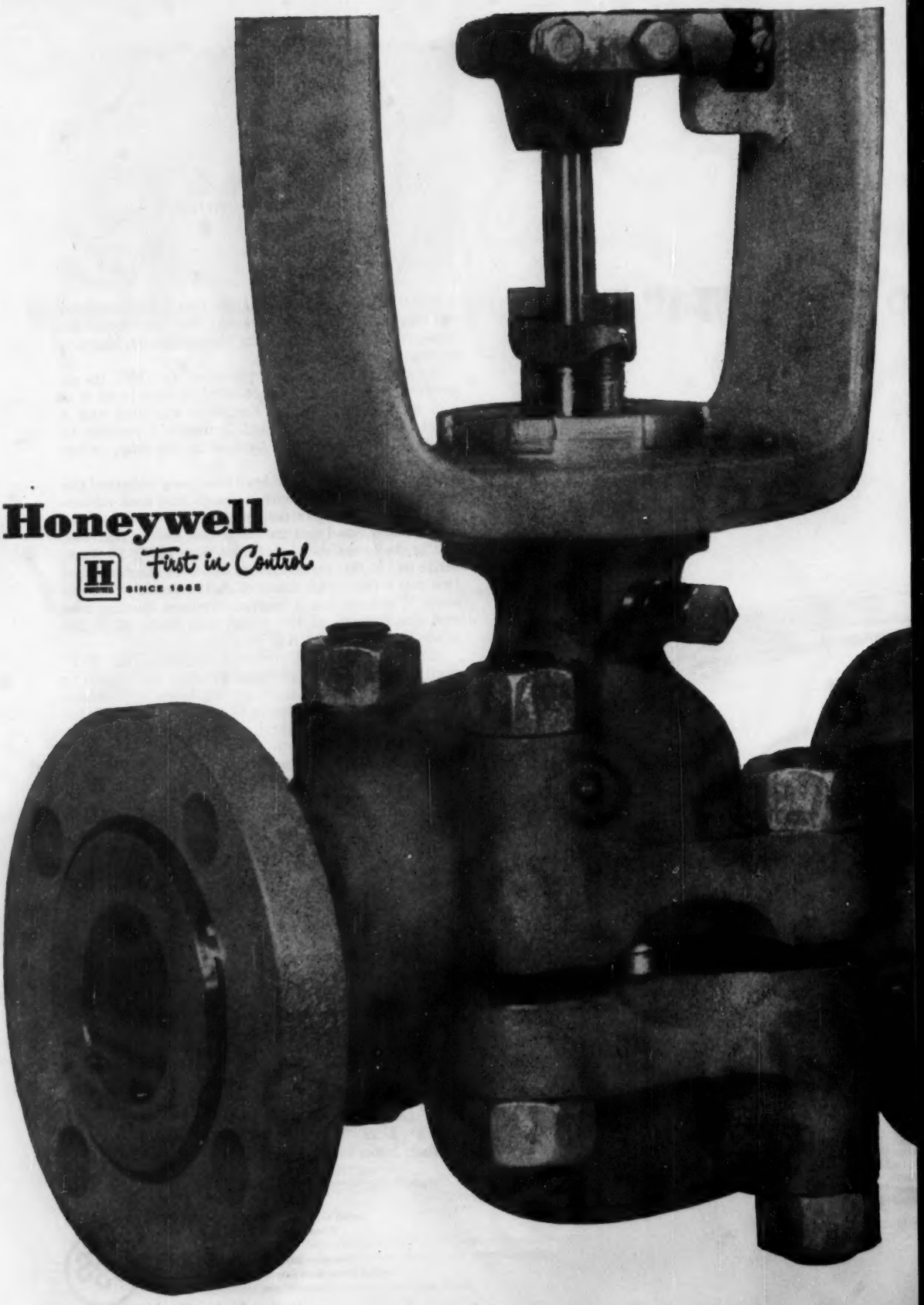
**Or perhaps your application calls for the split-body with fixed flanges and the economical diaphragm actuator.**

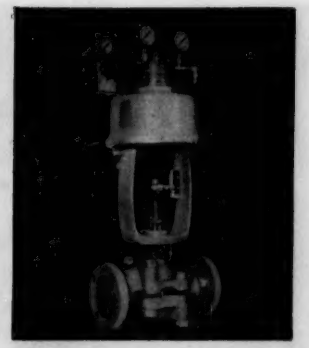


**With high temperatures, you'd probably prefer this globe body valve, with either the cylinder or diaphragm actuator. In any case, the completeness of the Honeywell line lets you select the valve-actuator combination that's exactly right for the job... without pushing a valve beyond its design limits, without paying for more than you need. Write for Bulletin B-802-1.**

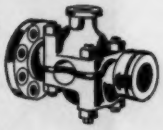


75th YEAR PIONEERING THE FUTURE **Minneapolis-Honeywell, Fort Washington, Pa.**


Honeywell
First in Control
SINCE 1885



**Now, a new split-body valve makes possible a flexible intermix of Honeywell valves and actuators—a combination designed for both economy and perfect matching of valve to application. For example,**



**you can get the split-body valve with cost-cutting, clamped-in seat rings, separable flanges**





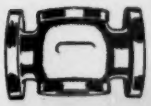
**and the new cylinder actuator.**



**Or perhaps your application calls for the split-body with fixed flanges and the economical diaphragm actuator.**



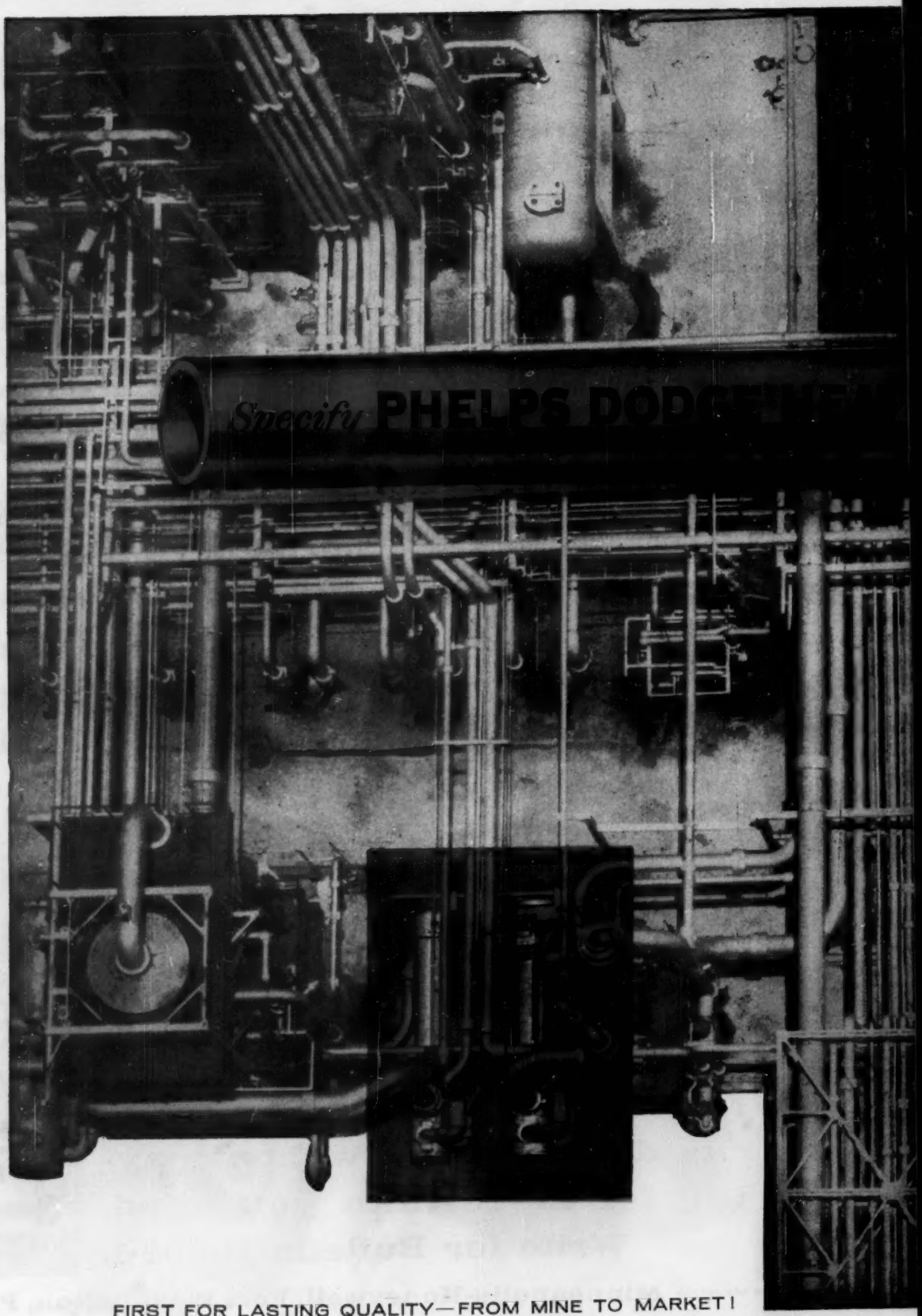
**With high temperatures, you'd probably prefer this globe body valve, with either the cylinder or diaphragm actuator. In any case, the completeness of the Honeywell line lets you select the valve-actuator combination that's exactly right for the job... without pushing a valve beyond its design limits, without paying for more than you need. Write for Bulletin B-802-1.**



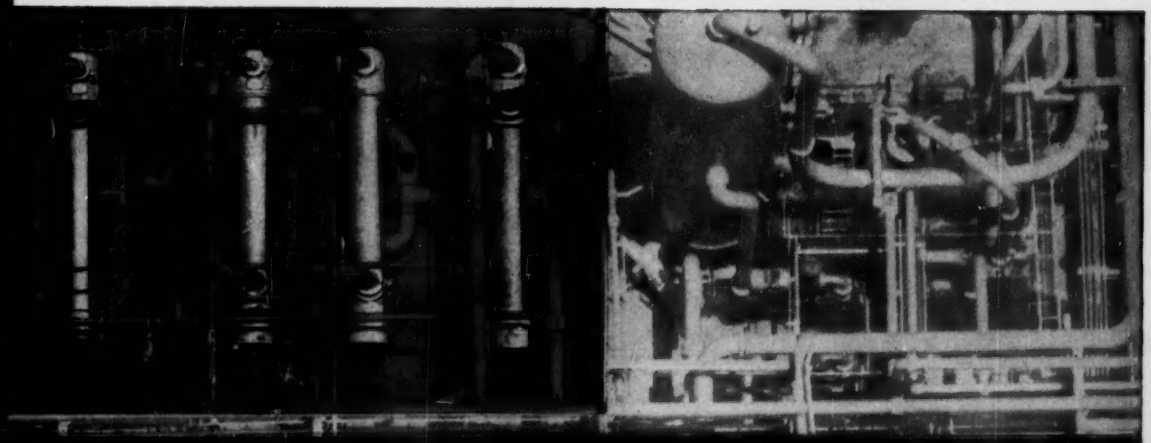


75th YEAR — ENGINEERING THE FUTURE

**Minneapolis-Honeywell, Fort Washington, Pa.**

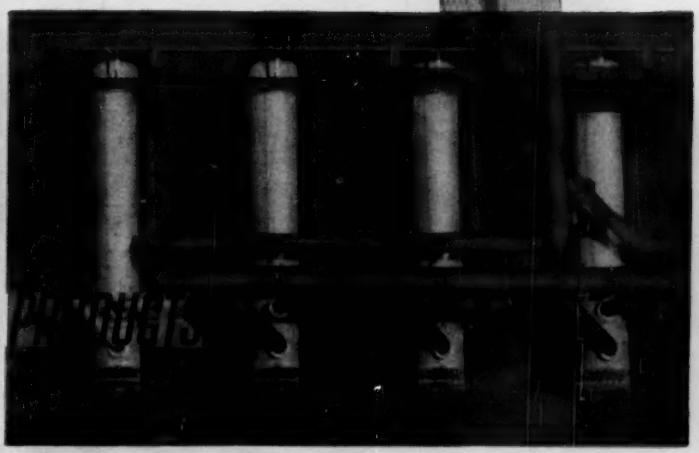



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# DE LAVAL

## CENTRIFUGAL COMPRESSORS

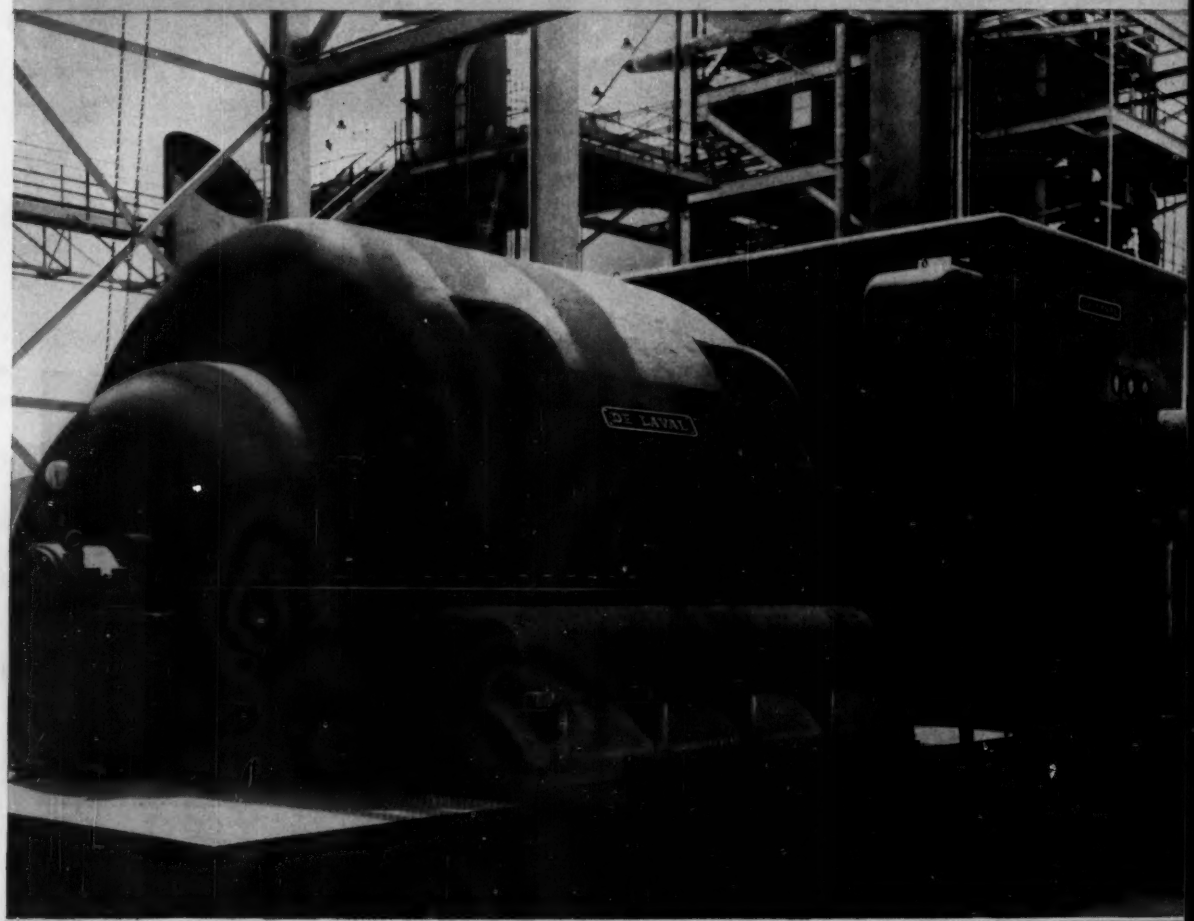
# 11,300

## Driven by automatic extraction steam turbine

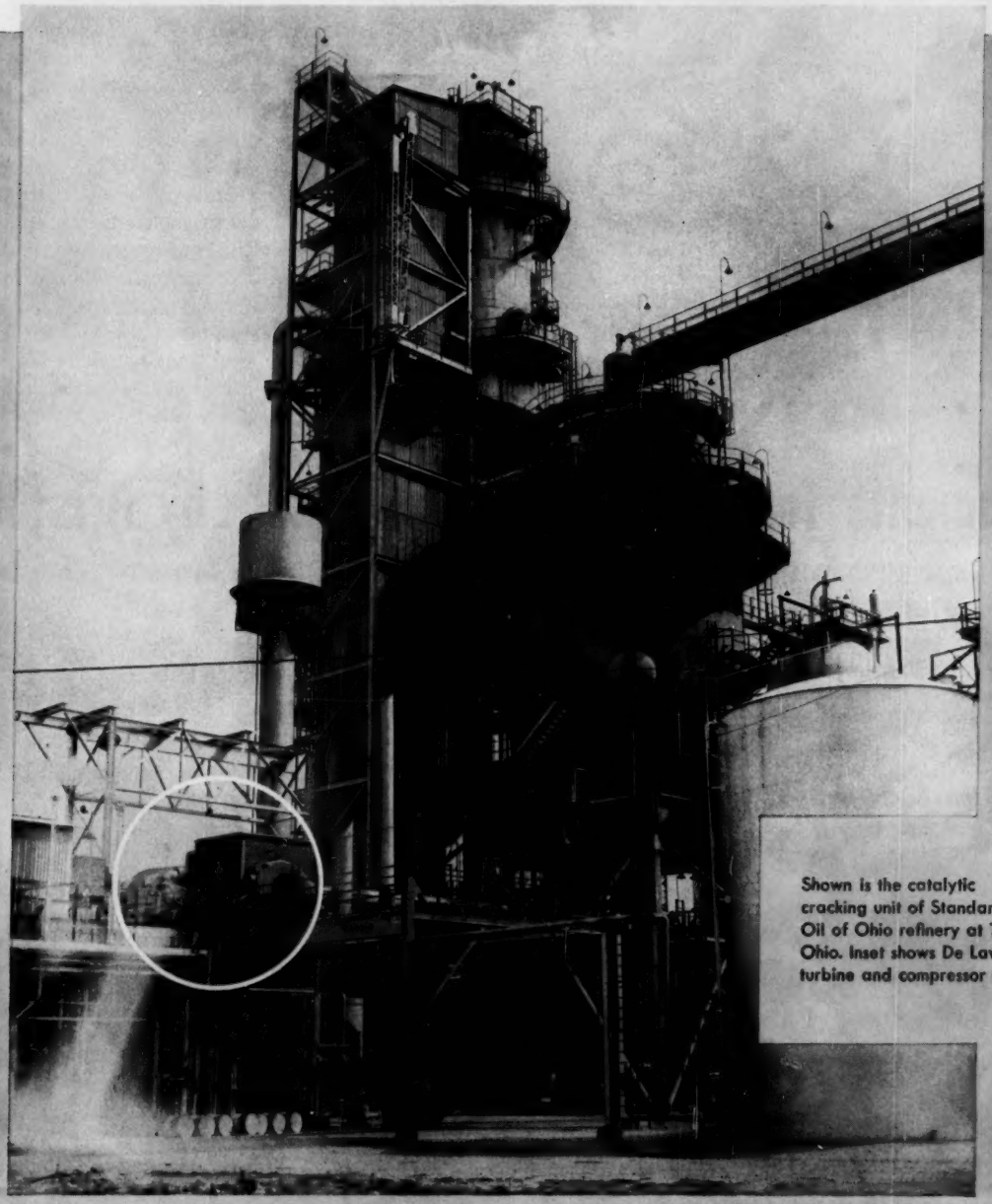
Shown below is the large 11,300 horsepower centrifugal blower which compresses air for the main blower service in catalyst regeneration at Standard Oil of Ohio's new refinery at Toledo, Ohio.

Driven by a De Laval single automatic extraction steam turbine, it compresses 110,300 cfm in four stages at 2800 rpm. Inlet pressure is 14.7 psia and discharge pressure is 40.7 psia. The turbine is designed for 600 psig ISP, 740F extracting at 55 psig, and exhausting to 28" Hg.

This is another example of De Laval proved performance.



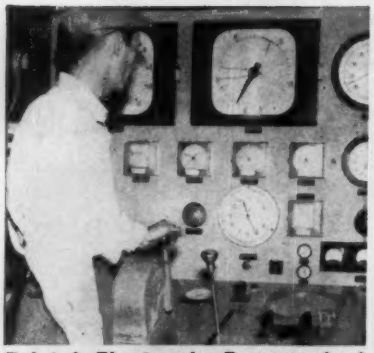
# horsepower DE LAVAL compressor for "cat cracker" at SOHIO refinery



Shown is the catalytic cracking unit of Standard Oil of Ohio refinery at Toledo, Ohio. Inset shows De Laval turbine and compressor unit.

DE LAVAL *Steam Turbine Company*

803 NOTTINGHAM WAY, TRENTON 2, N. J.



**Bristol Electronic Dynamaster* Potentiometers** (top left on panel) and Bristol Metagraphic Miniatures (directly under Dynamasters) on control panel at Dofasco. Bristol instruments at Dofasco monitor such important variables as oxygen pressure and flow (current rate and total), lance position and lance cooling water temperature, flow and pressure and other temperatures.

*T.M. Reg. U.S. Pat. Off.

**Growth of oxygen steelmaking is** one of the most exciting steel-industry advances during the past decade.

And Bristol instruments are playing an ever increasing part in this production revolution—from the first basic oxygen (L-D process) steelmaking plant on the North American Continent (see photos) to oxygen-using modifications of open-hearth furnaces, bessemer converters, and electric furnaces.

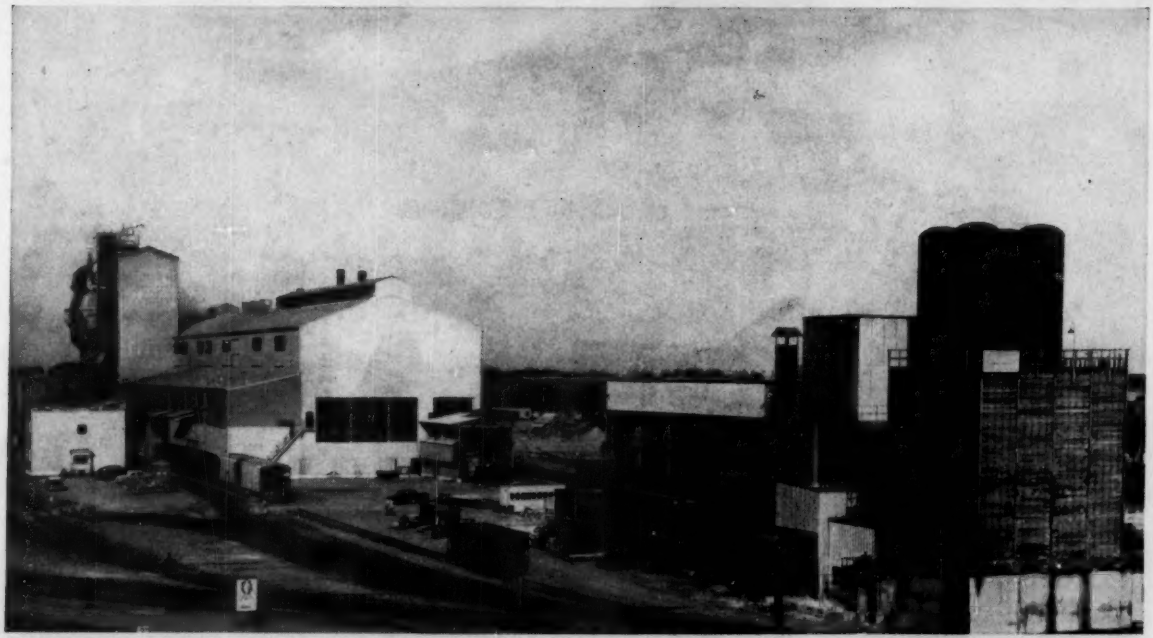
Here are just a few of the important variables Bristol instruments measure, indicate, record, or automatically control in modern oxygen steel plants: Oxygen pressure and flow (current rate and total), oxygen lance position, lance cooling water temperature, flow and pressure, fuel (coke-oven, natural gas, oil) flow, totalized flow and pressure—as well as complete telemetering and dispatching-center instrumentation for both fuel and oxygen pipelines.

A complete line of Bristol pyrometers—radiation, thermocouple and resistance models—and accessories are offered for every temperature range ... from −125° F to 5000° F... in every kind of steel plant.

Get complete data! Before committing your steel plant to *any* modernization program, find out how *Bristol* can solve your instrumentation problems. Write: The Bristol Company, 109 Bristol Road, Waterbury 20, Conn.

O-30

# Instruments for oxygen steelmaking... by Bristol



**First basic oxygen steelmaking plant in North America** at Dominion Foundries and Steel, Ltd., (Dofasco) at Hamilton, Ontario, Canada. Oxygen plant in foreground; steelmaking plant in distance. Bristol instruments play an important part in this pioneering operation.

**BRISTOL** ... for improved production through measurement and control

AUTOMATIC CONTROLLING, RECORDING AND TELEMETERING INSTRUMENTS

# Acid-proof answer to your valve problems...

# Lapp PORCELAIN VALVES!



There *are* no valve corrosion problems when you install Lapp porcelain valves on your chemical lines. Only porcelain and Teflon packing comes in contact with fluid being handled. And Lapp special porcelain is hard, dense and pure . . . homogeneous, non-porous and chemically inert . . . therefore impervious to corrosion from acids of all concentrations, except hydrofluoric.

**WRITE** on your letterhead for Catalog 567. It will put complete information on chemical porcelain at your fingertips. Lapp Insulator Co. Inc., Process Equipment Division, 1911 Poplar Street, LeRoy, New York.

**Lapp**

## 3 BASIC TYPES MEET VARIED REQUIREMENTS



**UNARMORED**—Valve body of white glazed porcelain. Maximum recommended temperature, 350° F.



**TUFCLAD® ARMORED** Porcelain body with exclusive Lapp armor casing of resin bonded fiberglass . . . for applications where accidental damage of porcelain becomes an immediate hazard to personnel or product. Maximum temperature, 225° F.



**ALUMINUM ARMORED** Recommended where armoring is needed and service temperature exceeds that of Tufclad. High strength silicon aluminum casting is cemented over porcelain body. Maximum temperature, 400° F.

All valve types are proof-tested leak free at 150 psig.—recommended for operation at 50 psig.

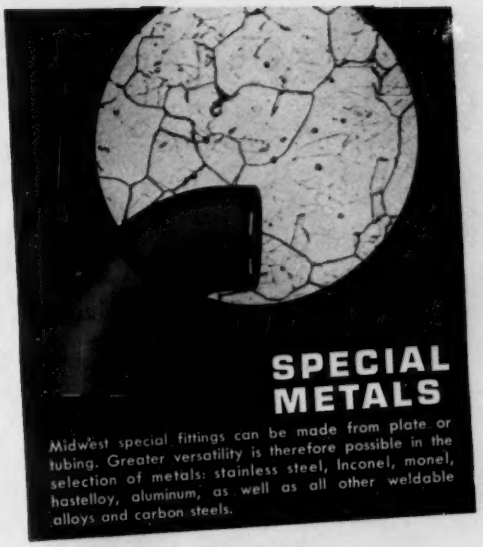


*The sentinel that never gets relief...* Day after day after day, for over 4 years this Beckman oxygen analyzer has maintained vigil on catalyst regeneration. Located eight stories above The Texas Company refinery at Wilmington, California, it has monitored unreacted oxygen, under demanding conditions, with only minimum routine maintenance. Analysis must be continuous, dependable, accurate. ⌘ This Beckman instrument is the only oxygen analyzer to use a direct paramagnetic measurement exclusively, which brings you these advantages: *Dependability...* under the most rugged conditions. *Simplicity...* with no auxiliary measurements to complicate analysis, no extra components requiring extra maintenance. *Accuracy...* with sensitivity and specificity to meet the most critical process requirements. ⌘ Whatever your application, if you want detailed specifications on an oxygen analyzer that withstands tough environments and gives you continuous, dependable answers, ask for Data File 14-47-08.

**Beckman**
*Scientific and Process Instruments Division*
*Beckman Instruments, Inc.*
*2500 Fullerton Road, Fullerton, California*

INSTRUMENTAL IN YOUR FUTURE 25 YEARS 1935-1960

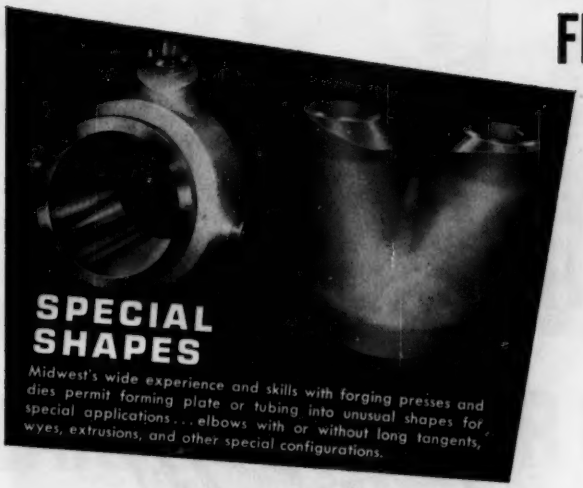
*It's a Fact:* A Beckman Infrared Analyzer has successfully controlled heat input to a refining tower for three years, maximizing ethylene recovery and minimizing methane content by analysis of the bottoms of a demethanizing absorber.



## SPECIAL METALS

Midwest special fittings can be made from plate or tubing. Greater versatility is therefore possible in the selection of metals: stainless steel, Inconel, monel, hastelloy, aluminum, as well as all other weldable alloys and carbon steels.

# MIDWEST SPECIAL FITTINGS MADE BY FITTING SPECIALISTS TO YOUR SPECIAL REQUIREMENTS



## SPECIAL SHAPES

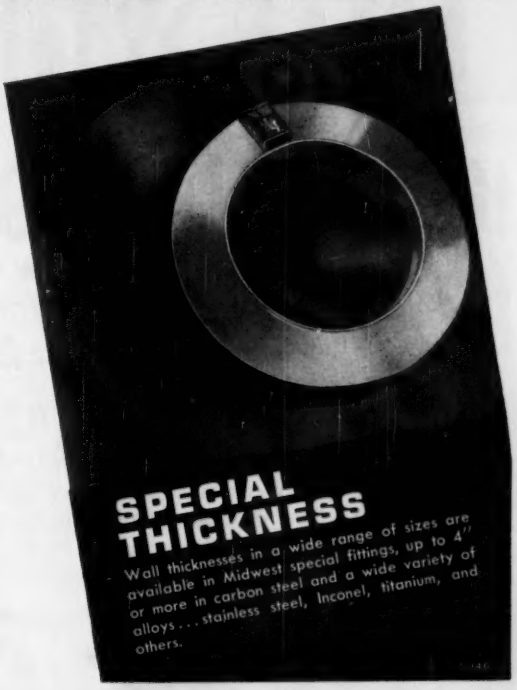
Midwest's wide experience and skills with forging presses and dies permit forming plate or tubing into unusual shapes for special applications . . . elbows with or without long tangents, wyes, extrusions, and other special configurations.

*For special fittings with any or all of the above characteristics, contact your local Midwest distributor . . . or call:*

**MIDWEST**

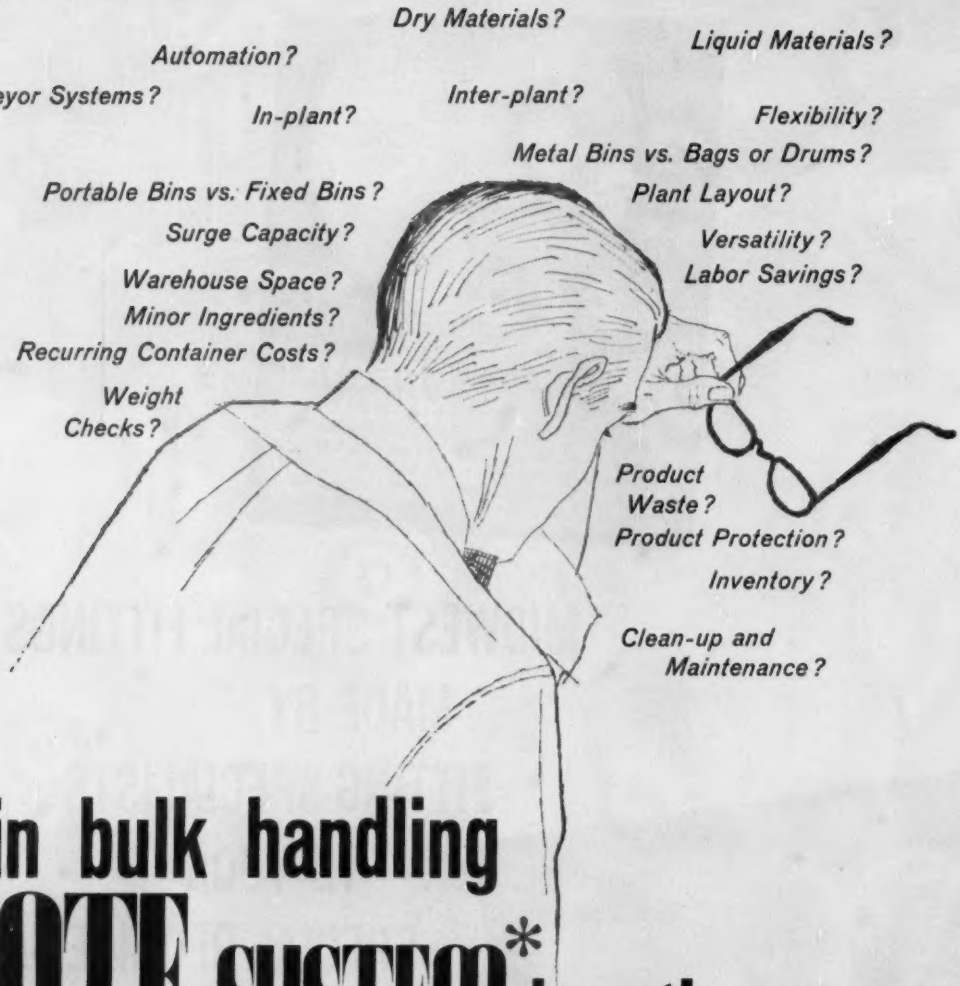
MIDWEST PIPING COMPANY, INC.

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## SPECIAL THICKNESS

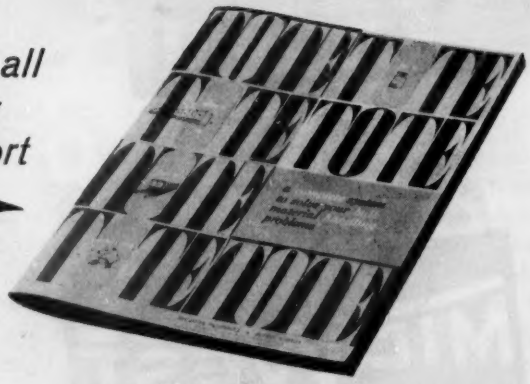
Wall thicknesses in a wide range of sizes are available in Midwest special fittings, up to 4" or more in carbon steel and a wide variety of alloys . . . stainless steel, Inconel, titanium, and others.




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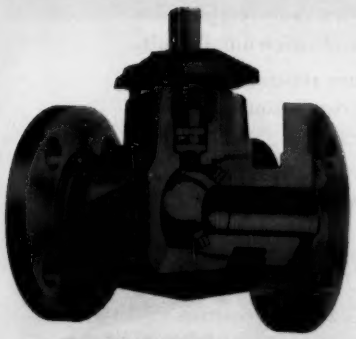
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# LEAKPROOF AFTER 600,000 CYCLES!



Proved in the laboratory, and in over five years of field service with such difficult ladings as acetone, propane, vinyl chloride, and lime and soda-ash slurry, W-K-M's ACF Ball Valve has earned a reputation for extra long life *without lubrication.* For example —

In one test, W-K-M opened and closed a 2″ standard production model under pressure 600,000 times. The valve still sealed tight, and there was no measurable wear on either the chrome-plated ball or the Teflon seats!

W-K-M's rugged ACF Ball Valves are available in carbon steel to ASA 300 lbs. (some sizes 600 lbs.), and in semi-steel, ASA 200 and 400 lbs. WOG.

Write for Catalog 1000.

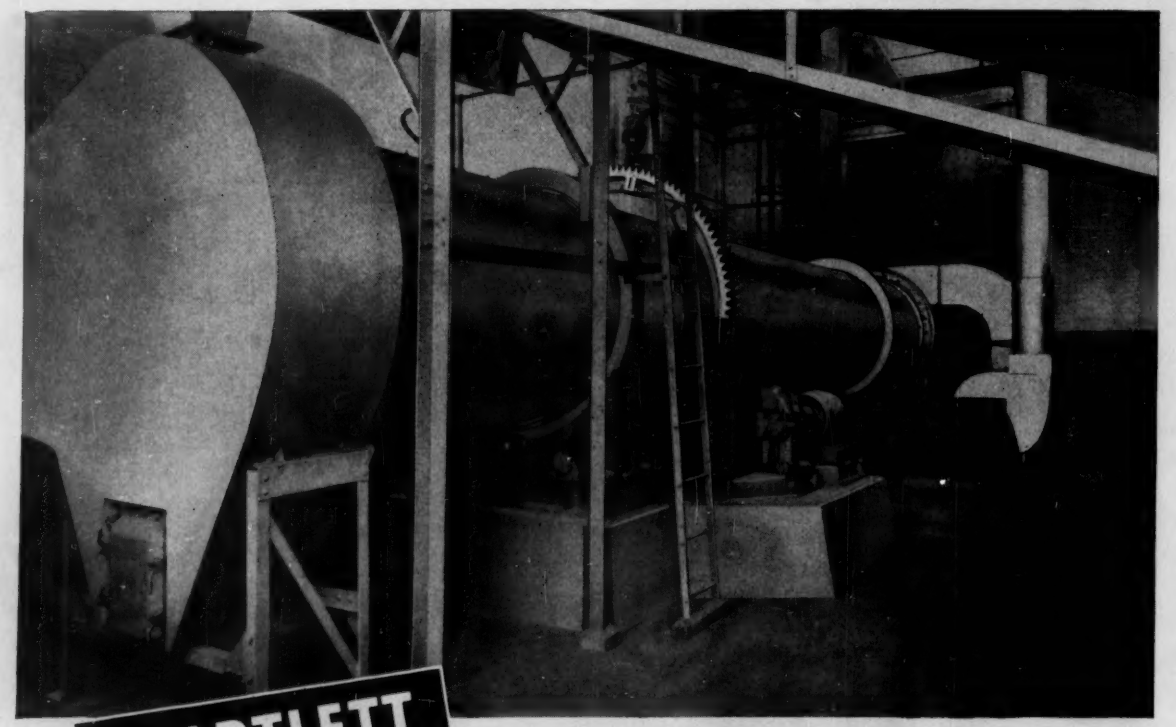
Conduit is full-bore; Teflon stem gaskets and seats are sealed from the lading flow.

***WHEN SO MUCH DEPENDS ON A VALVE . . . SPECIFY ACF BALL VALVES***

**W-K-M**

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Coppus Steam Turbine with Built-In Speed Reducer

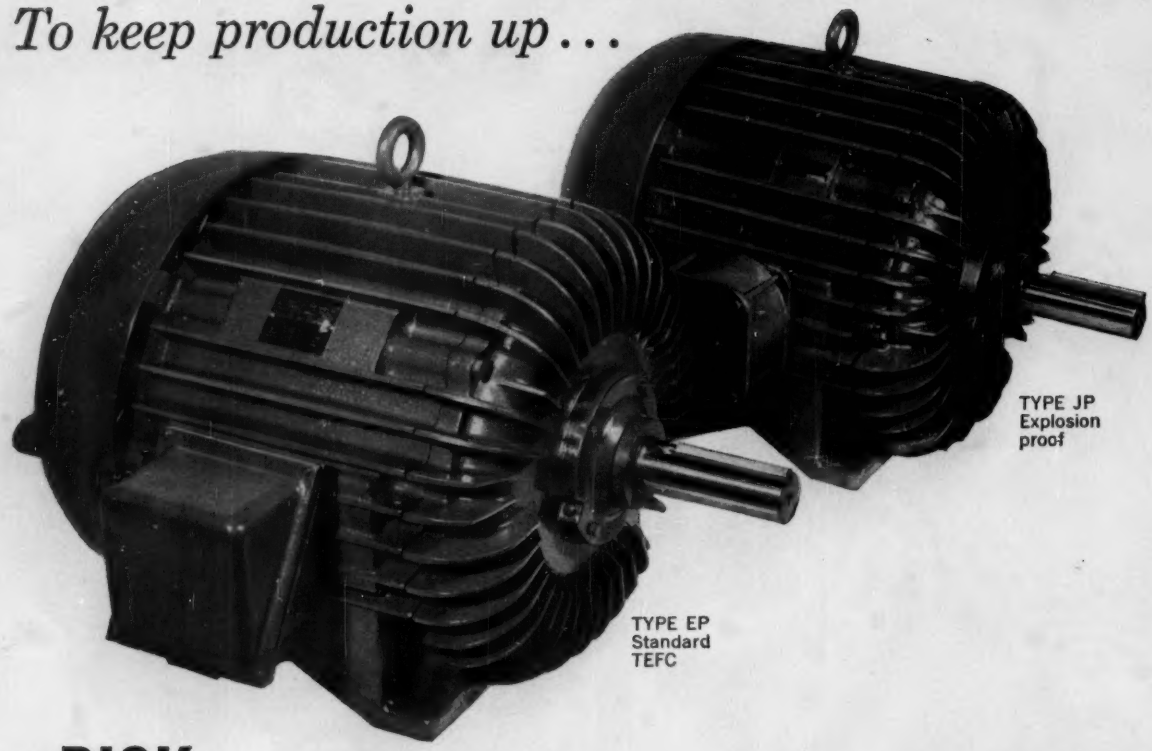
***STAMINA*** — You can literally *see* stamina in every dimension of a Coppus Turbine . . . rugged reliability that assures you stable, positive performance. It truly "wins" the Blue Ribbon with which it is marked . . . through advanced design, top quality materials, and thorough testing. With Coppus you're always certain of Blue Ribbon features such as these —

*A totally enclosed governor . . . totally enclosed, independently operated safety trip . . . easily replaceable packing and bearings . . . multiple steam nozzle control . . . brake rim for added safety . . . wide bucket "L" type wheel (optional) for minimum water rate.*

Coppus Turbines are built to customers' specifications, including API and NEMA standards. Sizes from 1 HP to 250 HP. All Coppus Products carry the same Blue Ribbon assurance of reliable performance. For further facts on turbines, send for new Catalog 200. COPPUS ENGINEERING CORPORATION, 231 Park Ave., Worcester, Mass. Sales Offices in *Thomas' Register*.

**COPPUS**
**STEAM TURBINES**

*To keep production up...*



TYPE JP
Explosion proof

TYPE EP
Standard
TEFC

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Here's a power-packed pair of Wagner® totally-enclosed fan-cooled motors —Type EP, standard, protected against damage from dust, abrasive, fumes, steel chips or filings; and Type JP, explosion-proof, for safe use in specified hazardous locations.

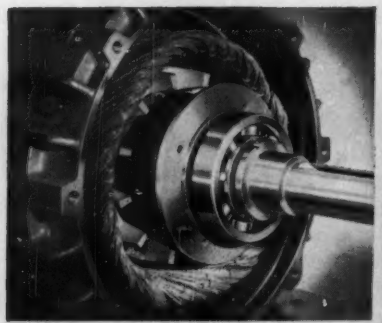
They'll keep your production rates up, delivering full rated horsepower under the toughest conditions . . . staying on the job with dependable, continuous service that means peak output. They're the perfect pick, for individual machines or for automated lines.

In the design illustrated, these motors are built in ratings through 100 hp in NEMA frame sizes 182-445U. Let your Wagner Sales Engineer show you how this protected pair (or larger Wagner enclosed motors through 500 hp) gets the job done. Call him, or write us for Bulletin MU-224.

**Wagner Electric Corporation**

6407 PLYMOUTH AVENUE, ST. LOUIS 33, MISSOURI

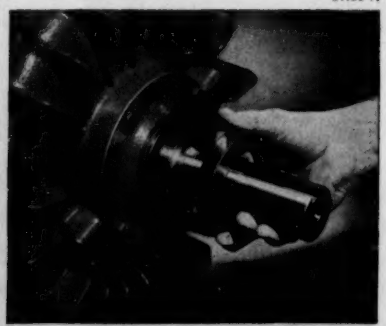
WM60-19



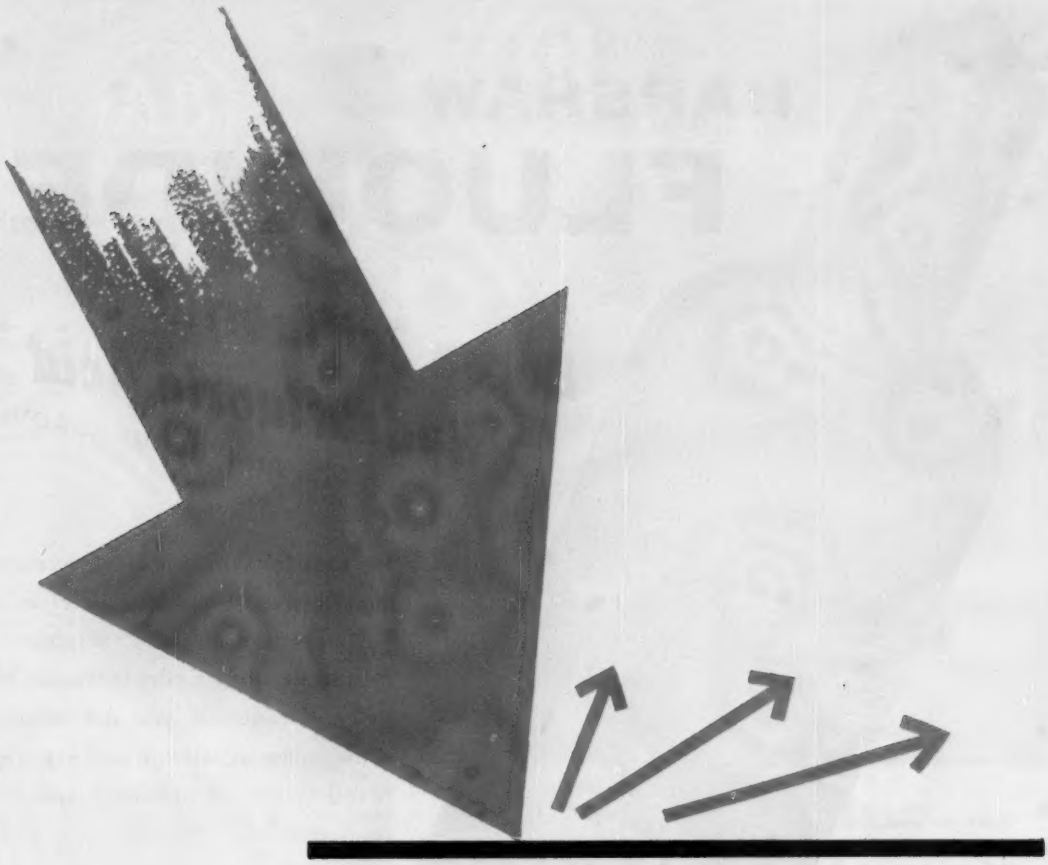
HEAVY-DUTY BALL BEARINGS... The ball bearings used in these motors are of the highest quality, with more than ample capacity to provide long, troublefree service under heavy loads.



BEARINGS CAN BE RELUBRICATED... Factory lubrication will last for many years under normal service, but openings are provided to permit relubrication that adds years to motor life under severe conditions.



SECURELY SEALED FOR LOW MAINTENANCE... Both ends of these motors have running shaft seals to keep the bearings clean. Bearing housings are effectively sealed to prevent escape of grease.



# Metallurgical Phenomena... and the metals to cope with them.

These are the stock-in-trade of the Lukens Application Engineer—whether the problem be one of abrasive impact (symbolized above) or corrosion or pressure or structural stress or high and low temperature. Investigation of the best steels for "problem" applications has been carried on for years by the Lukens Application Research team. We would welcome the opportunity to contribute the results of this research to your own design knowledge. Please contact us in your early design stages. Call collect: Joe Proctor, Manager of Application Engineering, Extension 422, Lukens Steel Company, Coatesville, Pennsylvania.

HELPING INDUSTRY CHOOSE STEELS THAT FIT THE JOB





# HARSHAW
# FLUORIDES

## Boron Trifluoride
## Hydrofluoric Acid
### ANHYDROUS . . . AQUEOUS

The uses for Fluorides are ever increasing. Harshaw Fluoride production also has increased steadily. Shipments of cylinders and tank cars leave our plant daily. If required, you are invited to draw on the knowledge and experience of our staff of technical specialists on Fluorides.

Write for your free copy of M.C.A. Chemical Safety Data Sheet SD-25 on properties and essential information about...
**HYDROFLUORIC ACID**
**Anhydrous and Aqueous**

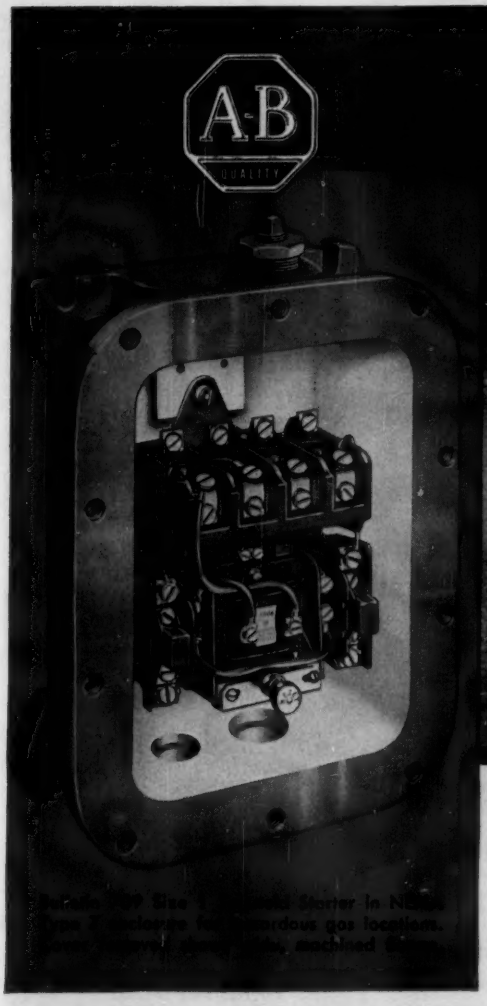
**THE HARSHAW CHEMICAL CO.**
1945 EAST 97th STREET • CLEVELAND 6, OHIO
Chicago • Cincinnati • Cleveland • Detroit
Hastings-On-Hudson, N. Y. • Houston
Los Angeles • Philadelphia • Pittsburgh

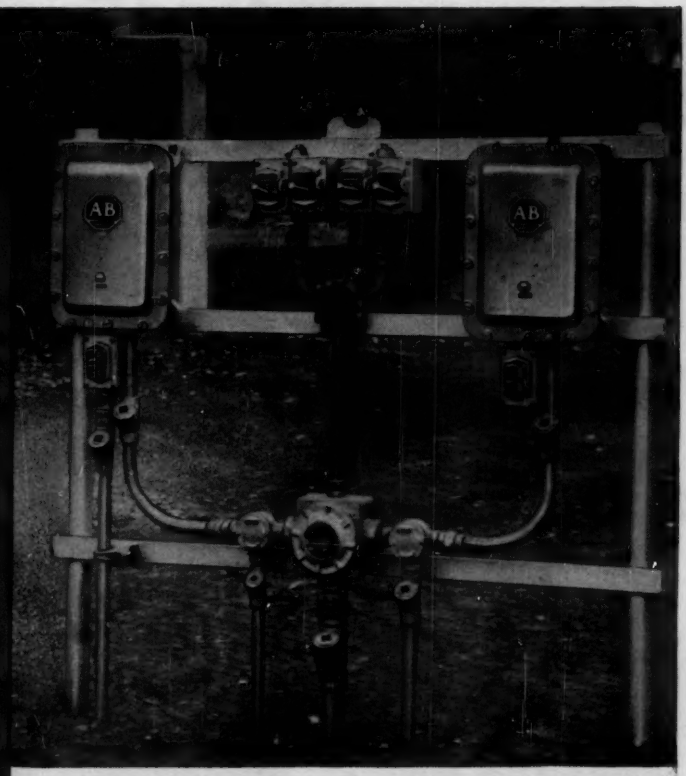
## Here is a helpful list of HARSHAW high-quality fluorides:

Ammonium Bifluoride
Ammonium Fluoborate
Barium Fluoride
Bismuth Fluoride
Boron Trifluoride Complexes
Chromium Fluoride
Copper Fluoborate
Fluoboric Acid
Fluorinating Agents
Frosting Mixtures
Hydrofluoric Acid Anhydrous
Hydrofluoric Acid Aqueous
Hydrofluosilicic Acid
Laboratory Fluorine Cells
Lead Fluoborate
Lithium Fluoride
Metallic Fluoborates
Potassium Bifluoride
Potassium Chromium Fluoride
Potassium Fluoborate
Potassium Fluoride
Potassium Titanium Fluoride
Silico Fluorides
Silicon Tetrafluoride
Sodium Fluoborate
Tin Fluoborate
Zinc Fluoborate
Zinc Fluoride

HARSHAW







# Reduce Routine Inspections...

## *Save Time — Save Money with Allen-Bradley maintenance free starters*

The fact that Allen-Bradley motor starters operate over long periods of time—without attention of any kind—is of great value in hazardous locations where inspection requires removing and replacing of bolted enclosures.

A-B solenoid starters have the simplest switching mechanism yet devised. There is only ONE moving part—and this simplicity assures millions of trouble free operations. Also, the double break, silver alloy contacts are always in perfect operating condition—and remain so without attention. The reliable and permanently accurate overload relays protect against motor burnouts, regardless of time or atmospheric conditions. You cannot go wrong when you insist on Allen-Bradley *quality* motor control—especially for your most difficult requirements.

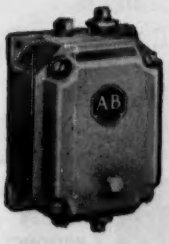
Allen-Bradley Co., 1337 S. First St., Milwaukee 4, Wis.
In Canada: Allen-Bradley Canada Ltd., Galt, Ont.



NEMA 8
Corrosive
Hazardous Gas



NEMA 4
Watertight
Weatherproof

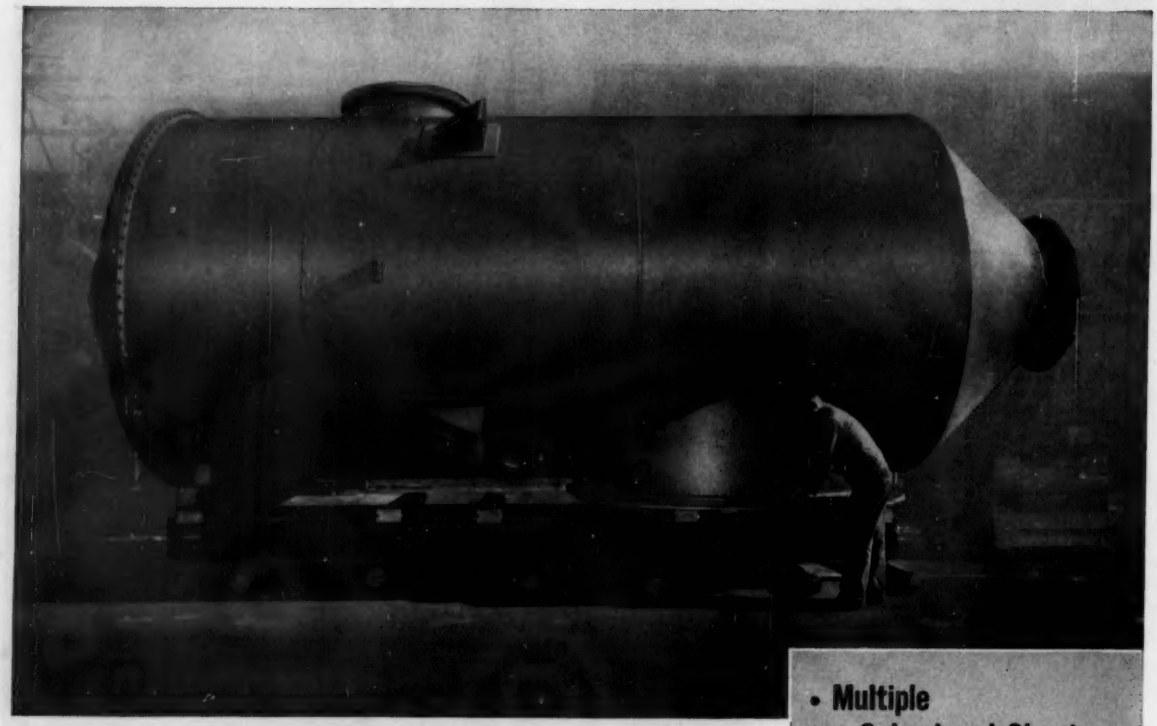


NEMA 9
Hazardous
Dust Locations



NEMA 11
Corrosive
Gas Locations

**ALLEN-BRADLEY**
Member of NEMA
Quality Motor Control



# MANHATTAN RUBBER LINED TANKS for PERMANENT Protection against Corrosion and Contamination

Costly process equipment for storing and handling corrosives deserves the degree of protection possible only with specially compounded, acid-proof Manhattan Rubber Linings. Thick, multiple calendered sheets of natural or synthetic rubber assure maximum durability under rough working conditions. The linings expand and contract with the tank metal under temperature changes . . . won't harden or crack. Their protection against most acids and alkalis is as fool-proof as 65 years of advanced technology can provide.

All Manhattan Rubber Linings are bonded to metal so securely actual tests have proved they can't be separated! And every Manhattan lined tank is tested under high voltage to assure flawless protection before being shipped to your plant. If your equipment is too large to ship to Manhattan, skilled crews will do the job at your location.

Be *sure* of permanent protection for your process solutions and equipment. Let an R/M representative show you the advantages of Manhattan Rubber Lined tanks, pipe and process equipment. Contact the Manhattan Rubber Lining plant or sales office nearest you . . . or write direct.

- Multiple Calendered Sheets
- Permanent Protection Against Corrosion, Contamination
- Permanent Rubber-to-Metal Bond
- Resistant to Acids, Alkalis, Abrasion, Temperature
- Largest Facilities Longest Experience
- Rubber Lining Plants at Passaic, N. J. North Charleston, S. C.

Write for Catalog No. 7115

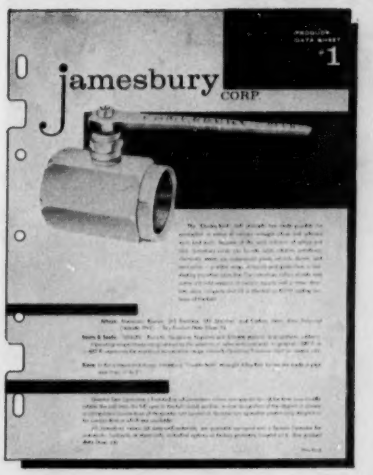
RM 1009

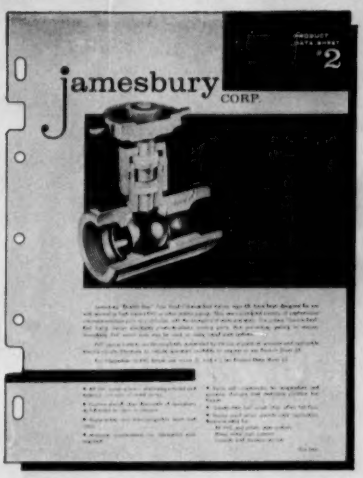
**RAYBESTOS-MANHATTAN, INC.**
MANHATTAN RUBBER DIVISION, PASSAIC, NEW JERSEY

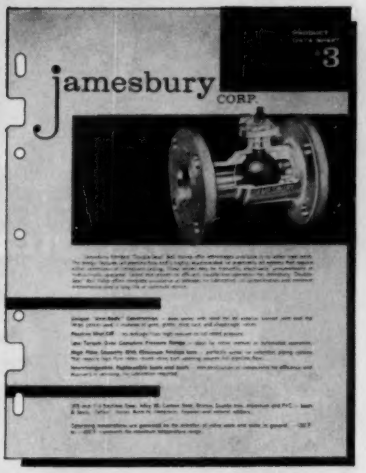
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ENGINEERED RUBBER PRODUCTS . . . MORE USE PER DOLLAR

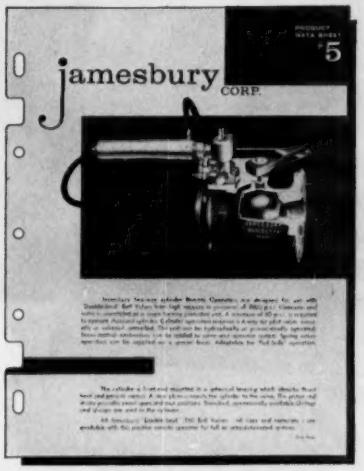
# Yours For The Asking!

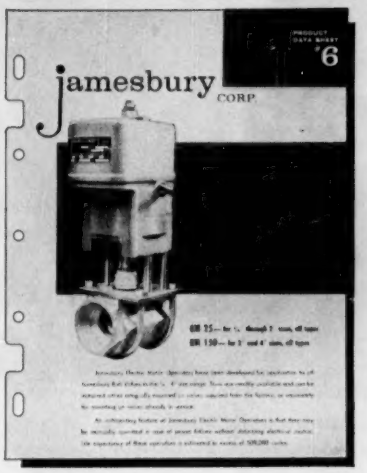


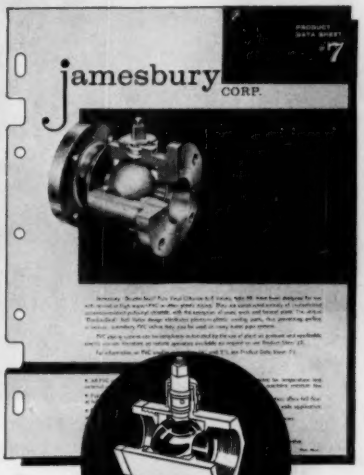



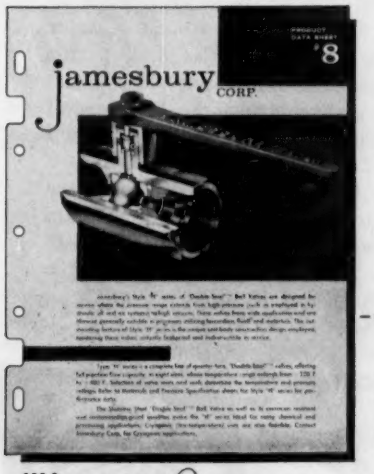




# FACTUAL DATA







## on Jamesbury BALL VALVES*

### AS VERSATILE AS INDUSTRY ITSELF

Get the full story on Jamesbury Corp.'s complete line of "Double-Seal" Ball Valves and accessories. Learn why the Jamesbury "Double-Seal" Ball Valve has been labeled "as versatile as industry itself". Get all the facts on materials, sizes, etc. They are yours for the asking: the facts about Jamesbury Corp. — the nation's foremost exclusive manufacturer of Ball Valves. * Patented

JAMESBURY CORP.
NEW STREET, DEPT. PDS, WORCESTER, MASS.
Please send me the Data Sheets checked below.

#1 #2 #3 #5 #6 #7 #8

Name..... Title.....

Company.....

Address..... City..... State.....

128-O

JAMESBURY BALL VALVES
HELPING BUILD OUR NUCLEAR NAVY

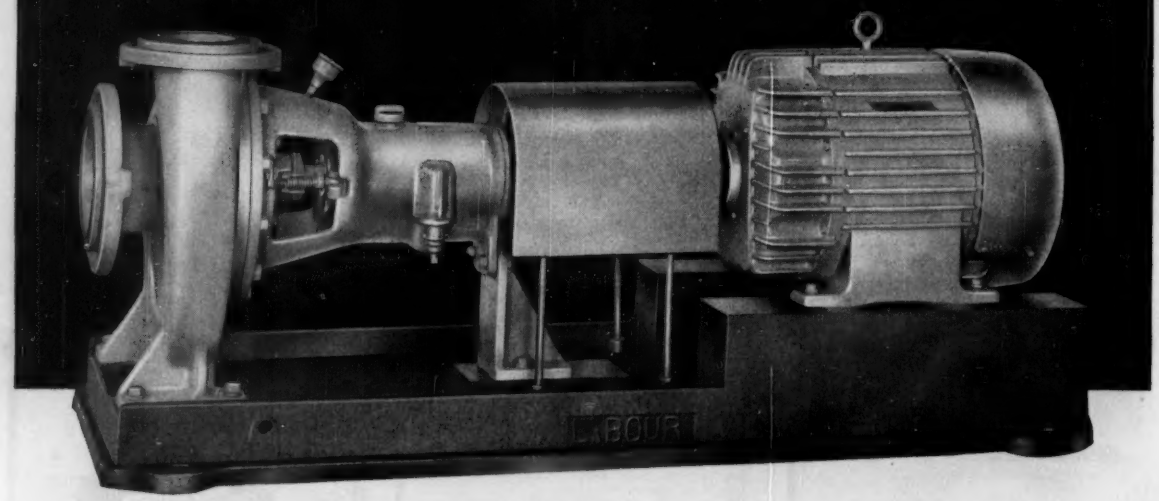
**JAMESBURY CORP., 62 NEW STREET, WORCESTER, MASS.**

*Distributors in Principal Cities*

# Now–

## Famous La Bour "Q" Performance

# Plus New Servicing Advantages




For many years LaBour Type Q pumps (non-priming) have been setting industry records for sustained efficiency and freedom from vapor- or air-binding. Now this same remarkable pump is available as Type SQ, so constructed that the impeller and all other rotating parts may be removed or replaced without disturbing pipe connections or motor.

Type Q and the new SQ pumps reduce liquid travel within the casing to *less than one revolution of the impeller.* This fact, together with other design features, produces efficiencies as high as 80% and more, with an open impeller and no close clearances inside the pump. Since performance does not depend on close clearances, relatively great increases due to corrosion or wear have negligible effect on the efficiency of these pumps.

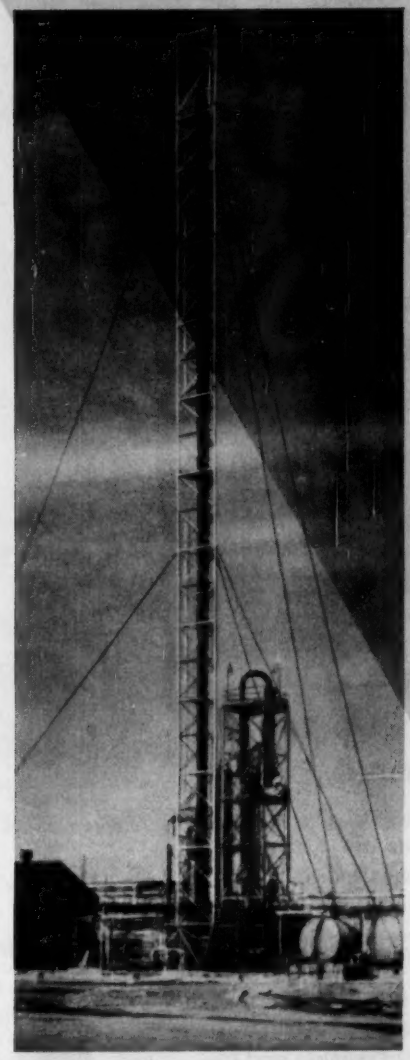
If you want to know how either of these units can help to reduce liquid-handling costs in your plant, write for our new bulletin on Q and SQ pumps.

ORIGINAL MANUFACTURERS OF THE SELF PRIMING CENTRIFUGAL PUMP

# LABOUR

THE LaBOUR COMPANY, INC. • ELKHART, INDIANA
WHITE PIGEON, MICH. • LONDON, ENGLAND

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## only HAVEG OFFERS Complete

1. **Equipment Line**
   - pipe & fittings
   - tanks
   - duct
   - towers
   - accessories
2. **Corrosion Resistance**
   - to acids
   - to alkalies
   - to organics
   - to solvents
3. **Selection of materials**
   - phenolics
   - furanes
   - polyesters
   - epoxies
4. **Technical engineering assistance**
   - in process design
   - in material selection
   - in installation recommendation

*Keep Ahead* with **HAVEG.**

FIRST IN *Engineered* PLASTICS

**HAVEG CORPORATION**
DIVISION OF
**HAVEG INDUSTRIES, INC.**
Plastics Park • Wilmington 8, Delaware

For thirty years Haveg has been solving corrosion problems of all types. Today Haveg is *the standard* of the corrosion industry. Haveg Engineers are trained by field experience to evaluate your problem and supply you with that plastic whose service characteristics will resist the chemical attack of your specific corrosive material.

Remember . . . with any corrosion problem . . . it's best to "Keep Ahead with Haveg."

*Other Operating Divisions:* American Super-Temperature Wires, Inc.—Burlington, Vermont • Blow Molding Division—Bridgeport, Connecticut • Chemical Materials Division—Wilmington, Delaware
Haveg Corporation—Wilmington, Delaware • Hemisphere Products Corporation—Rio Piedras, Puerto Rico • Reinhold Engineering & Plastics Co., Inc.—Norfolk, California

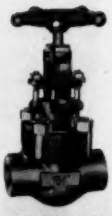



# NEW VALVE-OLOGY

## shuts off costly maintenance

Hancock 600# Steel Valves incorporate new concepts in valve-ology that reduce valve maintenance and equipment down-time. The forged steel bonnet and body have butting flanges so strong no distortion is possible. The flanges form a bonnet joint that utilizes the sealing power of a Flexitallic* gasket so effectively not even pressures exceeding ten times the rating of the valve can cause a blowout.

Hancock valve-ology makes full use of stainless steel to reduce your valving cost. Seat, disc, stem, swing bolts and nuts, thread bushing, packing gland follower—all are stainless steel. Globe, Angle, "Flocontrol", Lift Check, and Hi-Pressure Drop designs available. A high degree of standardization simplifies servicing and inventory needs. Your industrial supply distributor will gladly give you full details on Hancock Valve quality and performance. Phone him today.



Hancock 600# Steel Globe Valve. Type 5500 Line. Sizes: ¼" thru 2".

*Trademark of Flexitallic Gasket Company

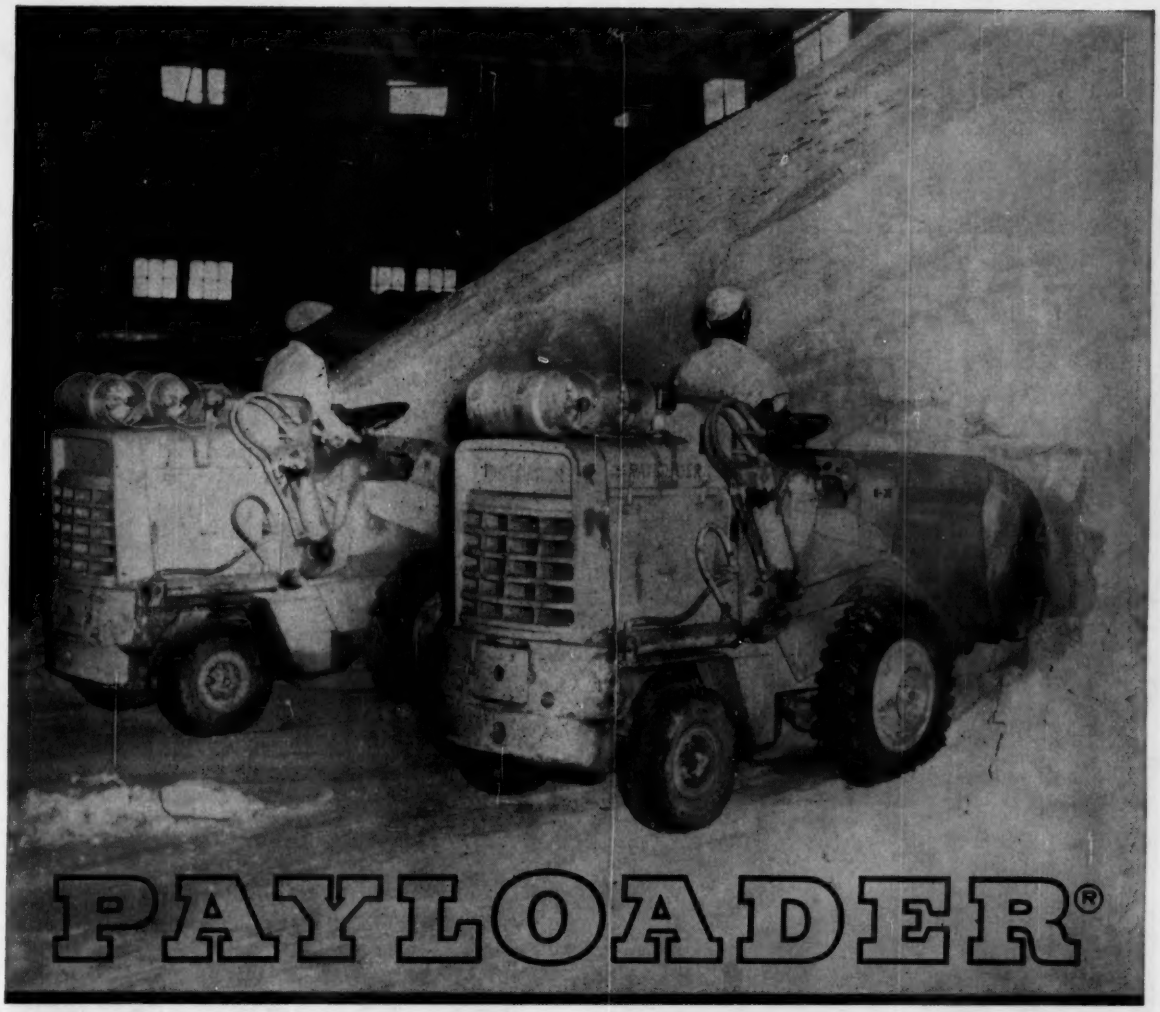
***HANCOCK STEEL VALVES***

***A product of***

**MANNING, MAXWELL & MOORE, INC.**

*Valve Division • Watertown, Massachusetts*

*In Canada: Manning, Maxwell & Moore of Canada, Ltd., Galt, Ontario*




# "Model H-25's are real producers . . .

*and have proven to be dependable on continuous operations", says C. L. Williams, Plant Supt. of Gulf Fertilizer Company, Tampa, Florida. "The maintenance on our two H-25s has been lower than on any loader previously used. We find the quick tip-back bucket action gets capacity loads without real strain on the loader, and delivery speeds are fast. We also save on tire wear with the power-shift transmission."*

Owner's reports on the H-25 "PAYLOADER" usually stress both its high output, and its dependable, low-maintenance performance. Mechanical excellence plus extraordinary protection against dust and dirt damage are the two basic reasons for these dual benefits.

**Mechanical Excellence** includes the Hough power-shift transmission — exclusive in its class with two speeds forward *and* reverse; power-steer; power-transfer differential; 4,500 lbs. breakout force; 2,500 lbs. operating capacity; shortest turning radius of only 6 ft.

**Extraordinary Protection** includes triple air cleaner system; cartridge-type oil filters on all three oil systems; sealed self-adjusting hydraulic service brakes; parking brake enclosed in transmission; special grease and oil seals on all vital points.

Your Hough Distributor wants to show you how this tractor-shovel can "ease the profit squeeze" of your bulk handling. See him soon, or send for full information.

HOUGH®

THE FRANK G. HOUGH CO.
LIBERTYVILLE, ILLINOIS
SUBSIDIARY - INTERNATIONAL HARVESTER COMPANY

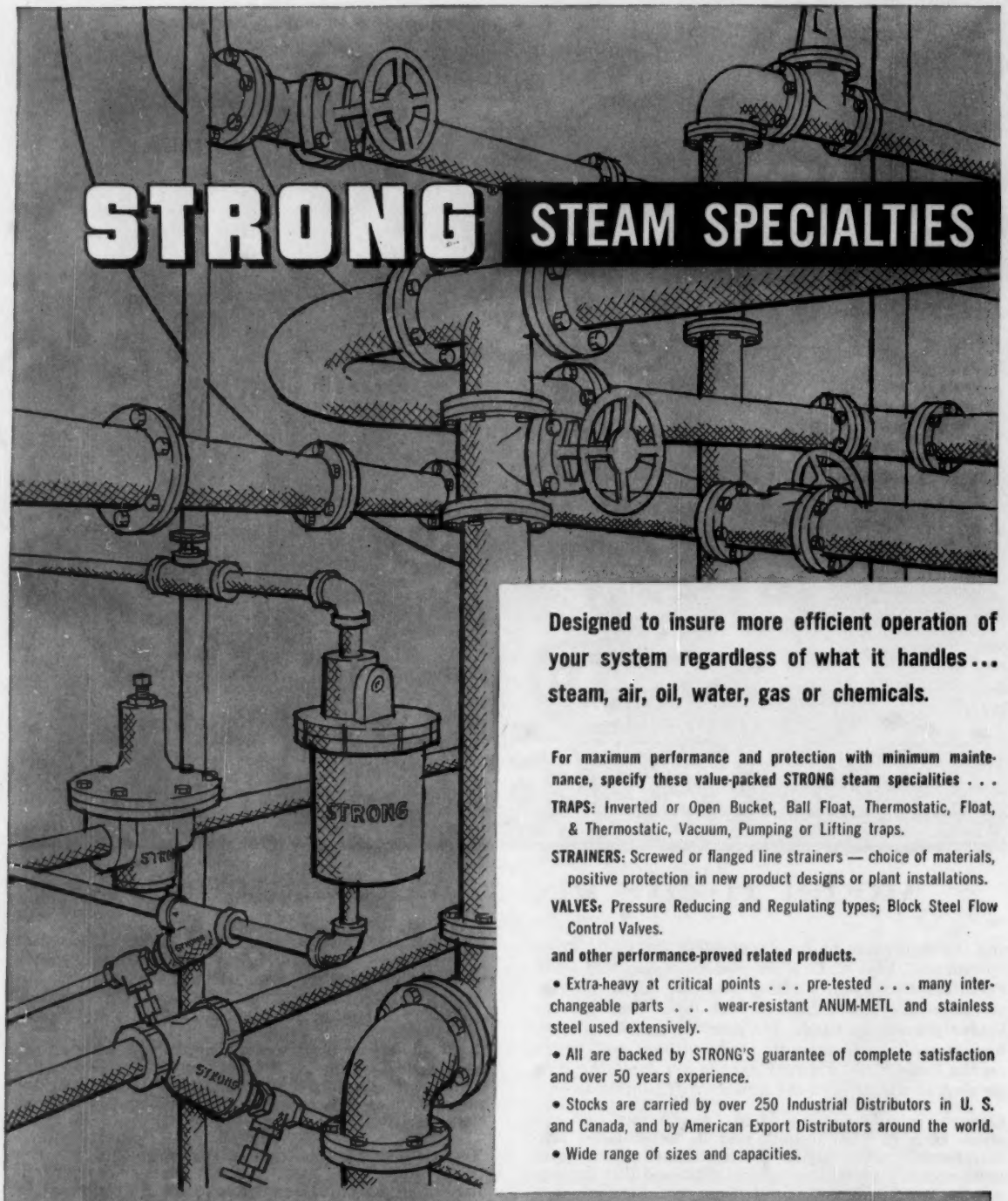
HOUGH, PAYLOADER, PAYMOVER, PAYLOGGER, PAYLOMATIC and PAY are registered trademark names of The Frank G. Hough Co.

**THE FRANK G. HOUGH CO.,** 754 Sunnyside Avenue, Libertyville, Ill. 11-A-1

Send "Industrial Materials Handling the PAYLOADER way."

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TITLE
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STREET
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**Designed to insure more efficient operation of your system regardless of what it handles... steam, air, oil, water, gas or chemicals.**

**For maximum performance and protection with minimum maintenance, specify these value-packed STRONG steam specialities . . .**

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**and other performance-proved related products.**

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DON'T YOU THINK IT WOULD BE MUCH MORE PRACTICAL IF WE SENT FOR **BRIDGEPORT'S** FREE NEW BOOK— 'SOLVING CORROSION PROBLEMS IN INDUSTRY'!"




If you convey anything through condensers or heat exchangers, this 20-page Bridgeport book is must reading. It tells how to lick problems involving two corrosive media... by using bi-metal Duplex Tubes ...each metal surface designed to resist corrosion from the media to which it is exposed.

Each industry has its own corrosion problems, and this fact-packed book illustrates ways to solve many of them. For your personal copy, just write, on your company letterhead, to the Bridgeport Brass Company, Bridgeport 2, Connecticut. Please address Dept. 5011.

Bridgeport Brass Co.

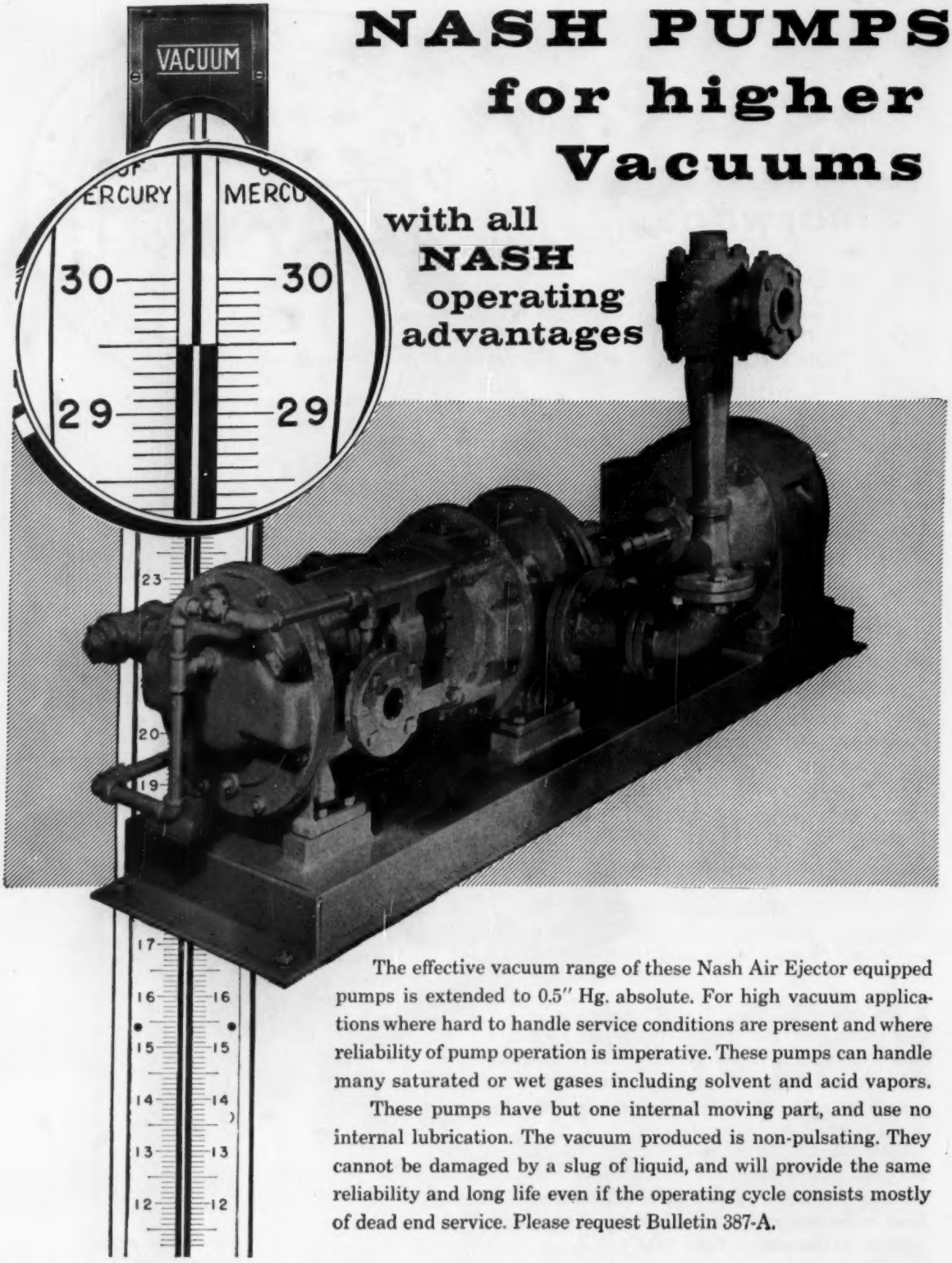
**BRIDGEPORT BRASS COMPANY**

Bridgeport 2, Connecticut • Sales Offices in Principal Cities

*Specialists in Metals from Aluminum to Zirconium*

# NASH PUMPS for higher Vacuums

with all **NASH** operating advantages

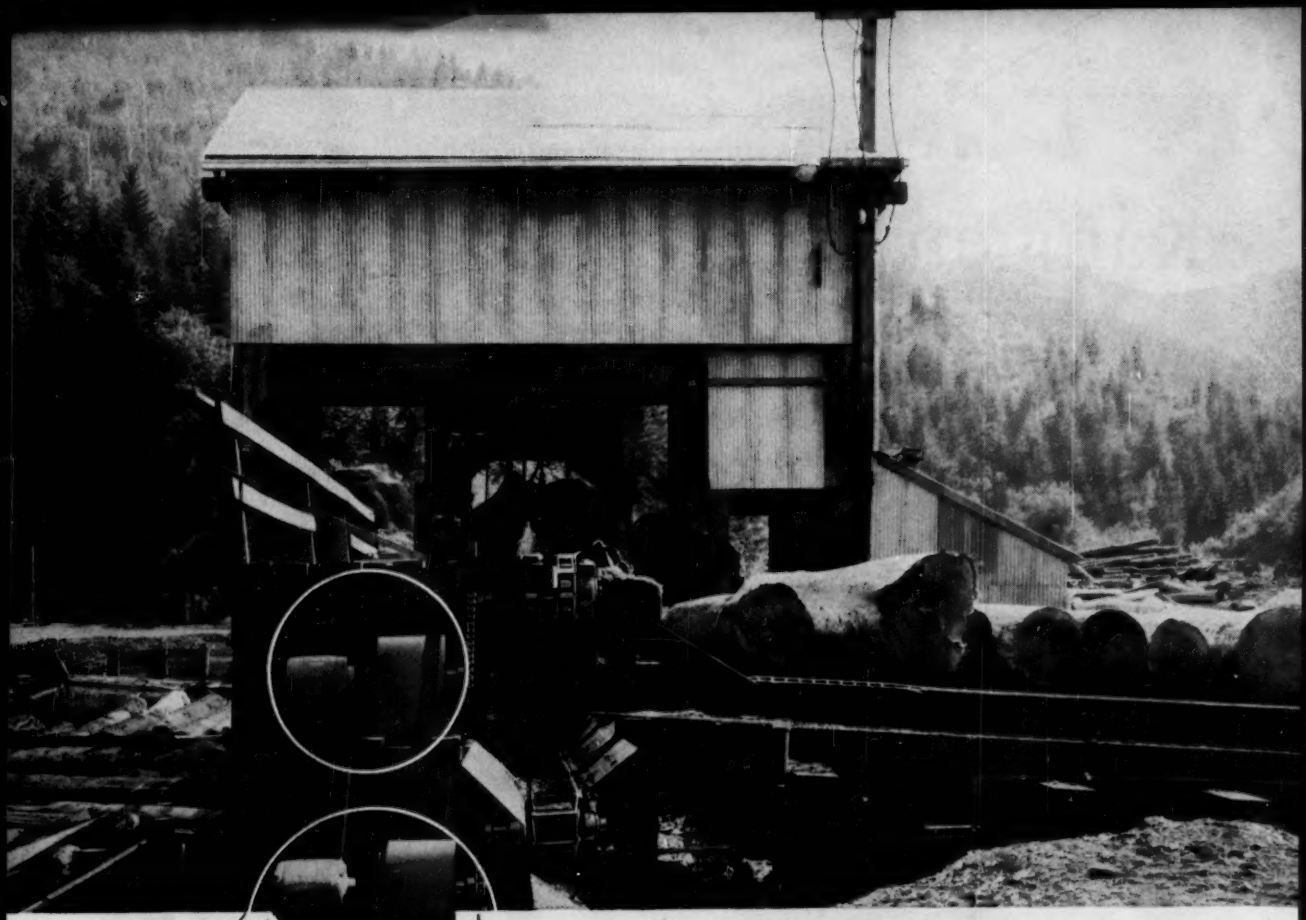



The effective vacuum range of these Nash Air Ejector equipped pumps is extended to 0.5″ Hg. absolute. For high vacuum applications where hard to handle service conditions are present and where reliability of pump operation is imperative. These pumps can handle many saturated or wet gases including solvent and acid vapors.

These pumps have but one internal moving part, and use no internal lubrication. The vacuum produced is non-pulsating. They cannot be damaged by a slug of liquid, and will provide the same reliability and long life even if the operating cycle consists mostly of dead end service. Please request Bulletin 387-A.

## NASH ENGINEERING COMPANY

**SOUTH NORWALK, CONNECTICUT, U. S. A.**



FALK Motoreducers driving log conveyor and refuse conveyor at the modern mill of The Bohemia Lumber Company, Culp Creek, Oregon.

# FALK *all-steel* Motoreducers give you longer service life

Whether your load conditions are normal or heavy, the extra rigidity of all-steel construction (more than twice that of cast iron) maintains better alignment of revolving elements under load...a vital factor in prolonging the service life of gears and bearings.

And if your installations are subject to shock loads, or accidental external impacts, you're way ahead when you install Falk All-Steel Motoreducers. These rugged units do not destroy themselves by tearing off their feet under jamming overloads, nor are their housings subject to cracks which both dissipate the vital lubricant supply and allow revolving elements to get out of alignment.

All-steel construction is one of the built-in extras that you get in Falk Motoreducers. Others include: (1) inherently stronger gear teeth (by AGMA standards), thanks to exclusive Falk extra-depth, high pressure angle helical gears; (2) maximum mechanical efficiency (98½% per gear mesh, under full load); (3) your choice of standard units (horizontal, vertical or right angle) to fit your precise requirements.

**HORSEPOWER RANGE: to 75 hp . . . STANDARD OUTPUT SPEEDS: 780 rpm (high) to 1.2 rpm (low).**

Prompt delivery from distributor stocks, or from warehouse or factory. Ask your Falk Representative or Authorized Falk Distributor for ***Bulletin 3100.***

**THE FALK CORPORATION, MILWAUKEE 1, WIS.**

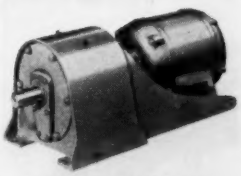
*MANUFACTURERS OF QUALITY GEAR DRIVES AND FLEXIBLE SHAFT COUPLINGS*

**Representatives and Distributors in most principal cities**

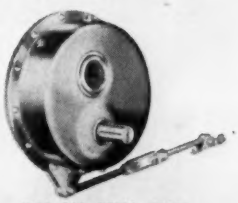
**FALK**

. . . a good name in industry

**Take your choice of all-steel drives when you specify Falk**



**THE FALK ALL-MOTOR MOTOREDUCER**
**...the original All-Motor unit**



**THE ALL-STEEL FALK SHAFT MOUNTED DRIVE**

Torque ratings to 44,000 lb-in at low speed shaft. Also available in flange-mount design.

FALK and ALL-MOTOR are Registered Trademarks.

# Kanigen®

*helps keep jet aircraft where the money is ...in the air*

Big jet aircraft make money only when they are in the air. Every minute they are earthbound is costly. You just can't take chances on failure of aircraft engines from fuel contamination, or on failure of refueling equipment. That's why those parts of Brodie BiRotor refueling meters and control valves that come in contact with the fuel are chemically plated with KANIGEN nickel alloy.

Brodie BiRotor meters have been used for controlling aircraft refueling for many years, and their internal parts have been KANIGEN-coated ever since this highly accurate method of plating difficult or complicated surfaces was perfected.

Do you have a corrosion or contamination problem? Is it a small part like the Brodie meter housing? Or is it a surface as large as the inside of a 20,000 gallon tank car? Whatever it is, there's a way to solve your problems with KANIGEN chemical nickel plating. Write or phone the nearest General American office.

*It pays to plan with General American.*





**GENERAL AMERICAN TRANSPORTATION**

KANIGEN DIVISION
**CORPORATION**
*135 South LaSalle Street*
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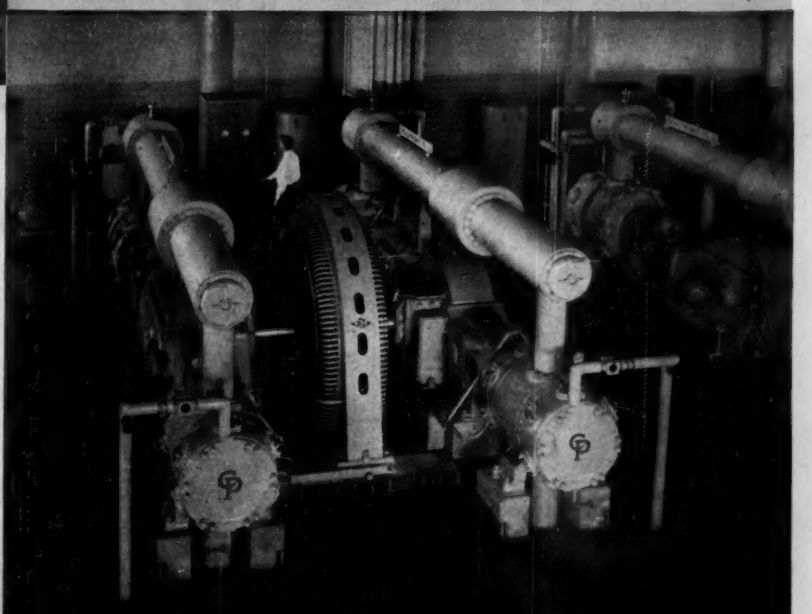
KANIGEN GENERAL AMERICAN

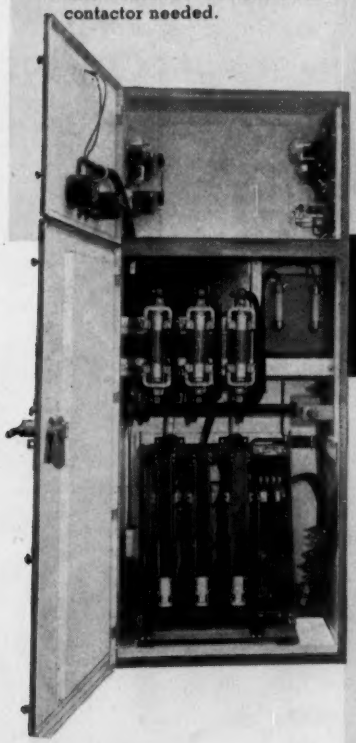


# The most complete synchronous motor protection you can buy

*Above and at right* • Four EC&M 1000 HP, 2300 Volt Synchronous Starters on air-compressor drives in Chrysler Corporation's new Ohio Stamping Plant at Twinsburg. Purchased and installed by Hatfield Electric Co., Cleveland, Ohio.

*Below* • Inside view of starter showing compact arrangement of fuses and contactor. The three arc shields slide out for quick access to both front and rear contacts—no draw-out of contactor needed.





## EC&M 2200-4800 VOLT STARTERS

• A push of the "start" button gives you complete protection during starting and running—*plus* EC&M *fully automatic synchronization.* Throughout the entire sequence, motor windings are completely protected and synchronization occurs at the most favorable time. Should the motor pull out of step because of voltage dip or overload, the field is automatically removed. Re-synchronization occurs when the motor re-accelerates the load. Short circuit protection is provided by current-limiting power fuses working in conjunction with EC&M's *"certified"* high-interrupting-capacity ZHA air-break contactor.

For complete details...

***WRITE FOR BULLETIN 8210***

**SQUARE D COMPANY**

EC&M DIVISION • CLEVELAND 28, OHIO

***wherever electricity is distributed and controlled***

8897-R

## INDUSTRIAL CHEMICALS

**ANHYDROUS AMMONIA** – This basic industrial chemical is available in commercial and refrigeration grades from three strategically located plants.

**AQUA AMMONIA ($NH_4OH$)** – An economical source of nitrogen and an easily handled alkali.

**AMMONIUM NITRATE** – In pelleted form. Typical analysis: Ammonium Nitrate content – 96% or more.

**AMMONIUM NITRATE SOLUTIONS** – NFS-83 and NFS-50. Ammonium nitrate-water solutions containing respectively 83% and 50% $NH_4NO_3$. For explosives, fluid catalysts, pharmaceutical applications.

**AMMONIUM SULFATE** – Diverse uses include fireproofing, fertilizers, leather tanning.

**ETHYLENE OXIDE** – Rocket propellant, fumigant, fungicide, chemical intermediate.

**ETHYLENE GLYCOL** – Also Di- and Tri-. Humectants, plasticizers, scrubbing solutions for gas dehydration, scores of other industrial uses.

**ETHANOLAMINES** – MEA, DEA, and TEA. Versatile, reactive, easy to handle. TEA available in 98% and commercial grades.

**FORMALDEHYDE** – Available as 37% Inhibited, 37% Low-Methanol, 45% Low-Methanol, 50% Low-Methanol.

**METHANOL** – 99.85% pure. In barge, tank car, and tank-truck quantities.

**NITROGEN TETROXIDE** – High energy oxidant for liquid rocket propellants. Easy to handle and store.

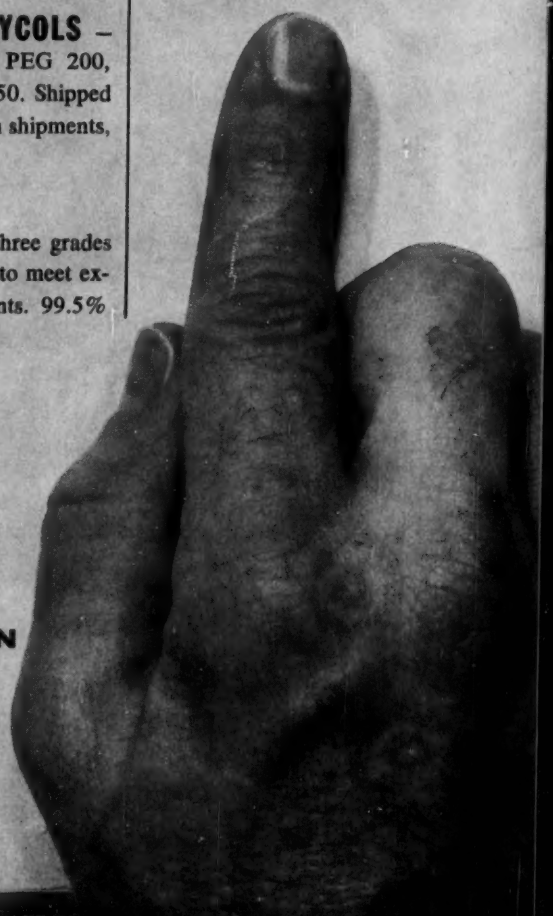
**POLYETHYLENE GLYCOLS** – Available in six forms: PEG 200, 300, 400, 600, 1000, 1450. Shipped in tank car or combination shipments, tankwagon and drums.

**SODIUM NITRATE** – Three grades – coarse, medium, fine – to meet exacting process requirements. 99.5% pure.

**UREA** – Multiplant production assures unfailing supply of this basic chemical in crystal and pelleted form.

**U-F CONCENTRATE-85** – Highly concentrated solution of urea (25%) and formaldehyde (60%). Easy to handle, economical source of these materials for resins and adhesives.

*For specifications and local offices, see our insert in Chemical Materials Catalog, pages 475-482 and in Chemical Week Buyers Guide, pages 37-44.*



BASIC TO AMERICA'S PROGRESS

Allied Chemical

**NITROGEN DIVISION**
Dept. AP 10-5-3, 40 Rector Street
New York 6, New York

2819

# ANACONDA HEAT EXCHANGER CLINIC

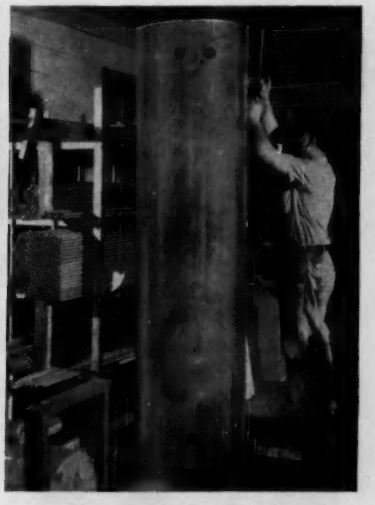


Dry-expansion water chillers nearing completion at Precision Heat Exchanger Co. for both Polaris-type and Thresher-type atomic submarines. Each vessel has two chillers. Here phosphorized copper tubes are being expanded into tube sheets of Everdur®, Anaconda copper-silicon alloy.

## Big 24" I.D. seamless 85-15 Red Brass tubes serve as shells on water chillers for our nuclear submarines

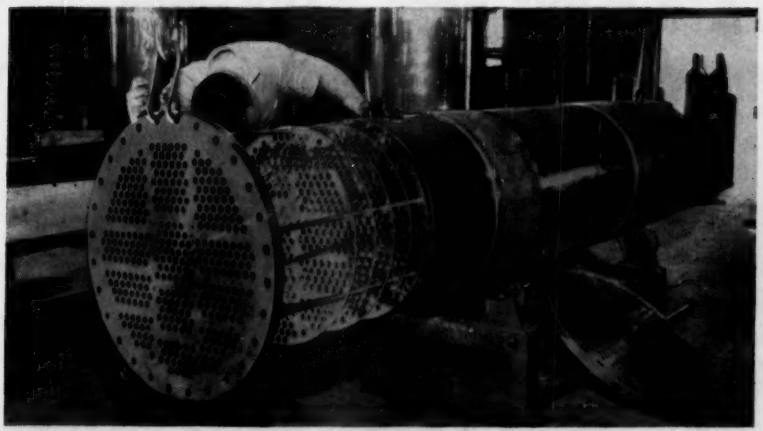
Many very special requirements dictated the design of the dry-expansion water chillers used in air conditioning our atomic submarines. They must be extremely compact to fit in very limited space. They must provide high corrosion resistance for utmost reliability in operation over long periods. And they have to be able to withstand the severe shocks and strains apt to be encountered in submarine service.

The chillers shown above are designed and built by Precision Heat Exchanger Co., Inc., of Westwood, N. J., for the York Division of Borg-Warner Corp., which is responsible for the over-all air conditioning systems. For the giant seamless tube which forms the shells of the chillers, Precision Heat Exchanger Co. turned to American Brass. And Mr. Hugh Eure, president, reports that despite their size and the hazards of shipping, the tubes have come through consistently round.





Top: Big seamless tube of Anaconda 85-15 Red Brass, 24" I.D. x 5/16" wall x 95 1/4" long, which will form shell of water chiller. Anaconda can produce seamless tube in commercial sizes up to 26.875" O.D. x .437" wall in length of 10 ft. for largest diameters, in copper and brass alloys. Everdur and Cupro Nickel are also available in slightly smaller diameters. Above: Welding an Everdur mounting bracket to the chiller by the metal-arc, inert-gas process.



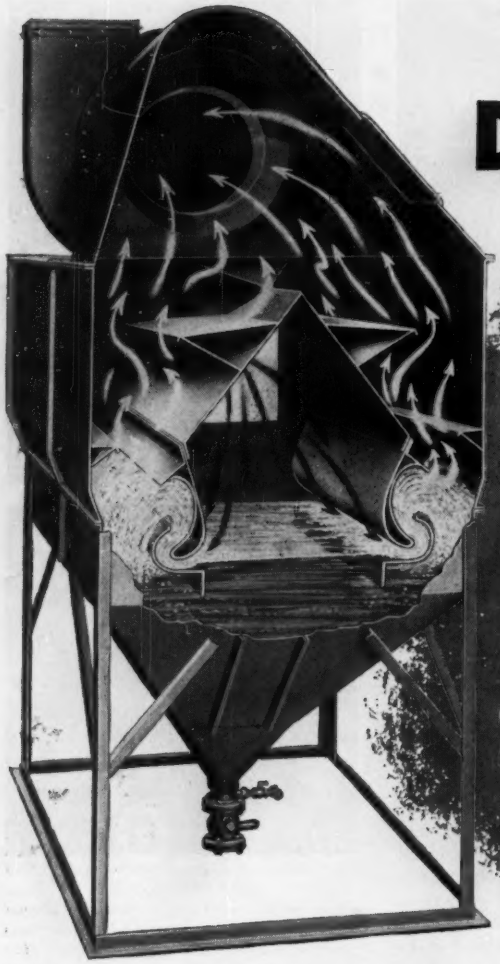
Inserting baffles and tube sheets into shell preparatory to tubing. Each chiller has 374 tubes of Phosphorized Copper-103, each 3/4" O.D. x .049" gage x 8 ft. long; 21 tube baffles of Yellow Brass, each 23 7/8" dia. x 1/8" thick; and tube sheets of Everdur-1010, each 28 3/8" dia. x 1 3/8" thick. Note mounting bands around center of shell. They are formed from 1/4" Everdur-1010 sheet and welded to the 85-15 Red Brass shell.

**TECHNICAL ASSISTANCE.** The Metallurgical Department of Anaconda American Brass Company is regularly working with the manufacturers and users of heat transfer equipment helping to select the alloys best suited for the service. For technical help or information on alloys and tubes, write: Anaconda American Brass Company, Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Ontario. 6073

**ANACONDA®**

**Tubes and Sheets for Condensers and Heat Exchangers**

*Anaconda American Brass Company*



## Do you have a
# DUST PROBLEM?

CALCIUM SULFATE
BAUXITE
T.N.T.
BARIUM SULFIDE
SULPHURIC ACID MIST
ALUMINUM OXIDE
PIGMENTS
LEAD OXIDE
PHOSPHATE DUST
PLASTICS
FERTILIZER DUST
ALUMINUM SILICATE
AMMONIUM SULFATE
INSECTICIDES
BARIUM CARBONATE
ALUMINUM POWDER
BARIUM SULFATE
LIME
CUPRIC OXIDE
CAUSTIC VAPORS
SOAP DUST

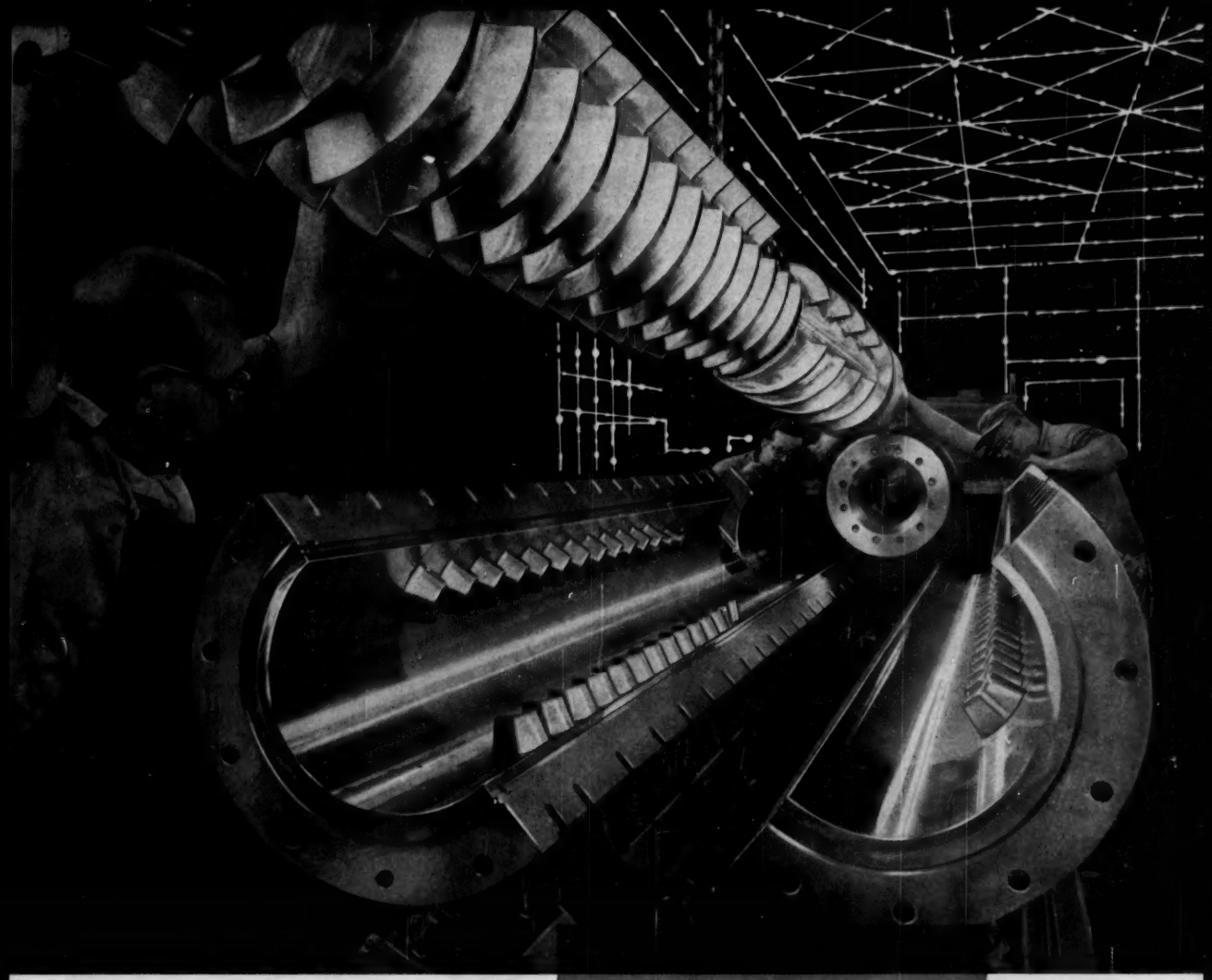
## AAF TYPE N ROTO-CLONE DOES MANY JOBS FOR CHEMICAL PROCESSORS

If your operations require collection of heavy dust loadings of all particle sizes, you've got a job for the AAF Type N ROTO-CLONE. The engineered simplicity of this hydrostatic precipitator assures highest efficiency and lowest maintenance costs.

The rugged Type N achieves its high efficiency from the combined action of centrifugal force and thorough intermixing of water and dust-laden air. Compact design makes for important space savings.

For complete information on this versatile wet collector, call your local AAF representative or write direct for Bulletin 277. Address Mr. Robert Moore, American Air Filter Company, Inc., 326 Central Avenue, Louisville 8, Kentucky.

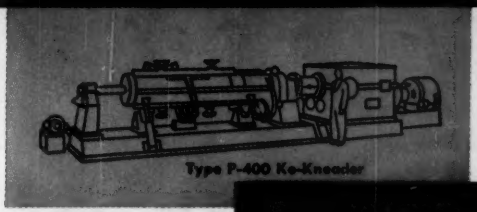
AAF **American Air Filter**
BETTER AIR IS OUR BUSINESS



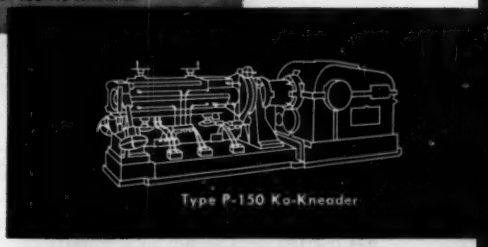
# B·P

## KO·KNEADERS (LIST SYSTEM)

### precision built for efficient continuous mixing



Type P-400 Ko-Kneader



Type P-150 Ko-Kneader

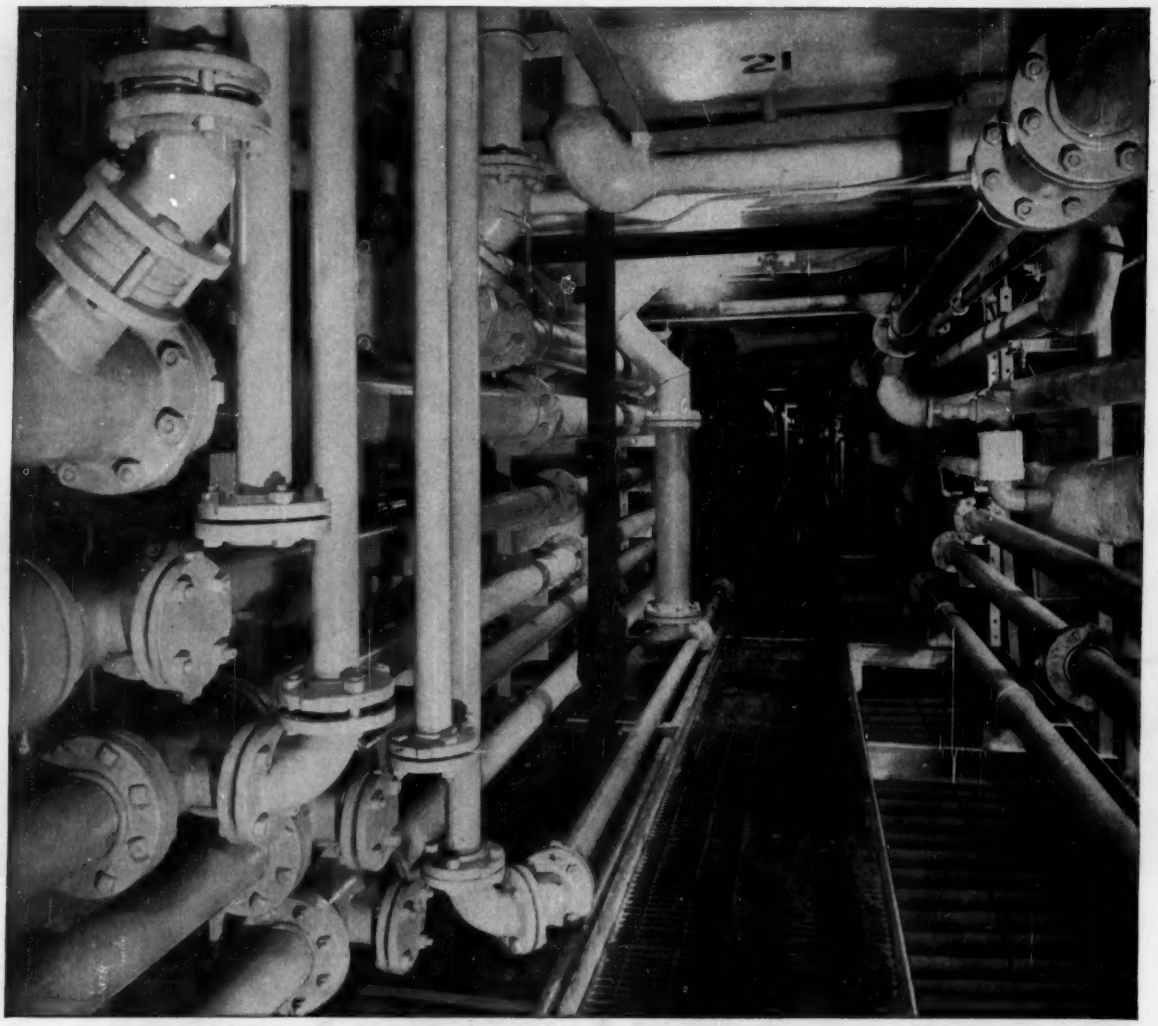
Precision built and skillfully engineered Baker Perkins Ko-Kneaders will convert your inefficient batch process to faster, more continuous operations. Less floor space is required and maintenance costs are materially reduced. With a Ko-Kneader, you not only get more production at less cost, but you give your customer a superior product, too.

B-P Ko-Kneaders are now mixing a wide variety of products such as plastics, carbon electrodes, food specialties, floor tile, solid rocket propellant fuels and many others. From this experience, proper recommendations can be made for your operation. However, if a new mixing problem is involved, test demonstrations can be arranged in the Baker Perkins Laboratory. Write today for engineering manual K-57 or contact your nearest Baker Perkins sales engineer.




**BAKER PERKINS INC.** CHEMICAL MACHINERY DIVISION
SAGINAW, MICHIGAN

DOW | **SARAN LINED PIPE**




## After six years of hot sulphuric acid . . .

### Saran Lined Pipe still performs dependably

When 20,000 linear feet of pipe must carry a constant stream of hot sulphuric acid . . . when production requirements make pipeline failure intolerable . . . pipeline dependability is the lifeline of the plant. For the past six years, Saran Lined Pipe has carried dependably an unending flow of corrosive chemicals at Industrial Rayon Corporation's Painesville, Ohio, plant.

The installation shown above carries hot sulphuric acid and other chemicals used in Industrial Rayon's Continuous Process method of making tire cord. This Saran lined supply and return piping, serving all of the plant's spinning machines, carries the solutions from lower levels to spinning machines on the main floor. Pumping pressures range from 45 psi upward, and solution temperatures are above 125° F.

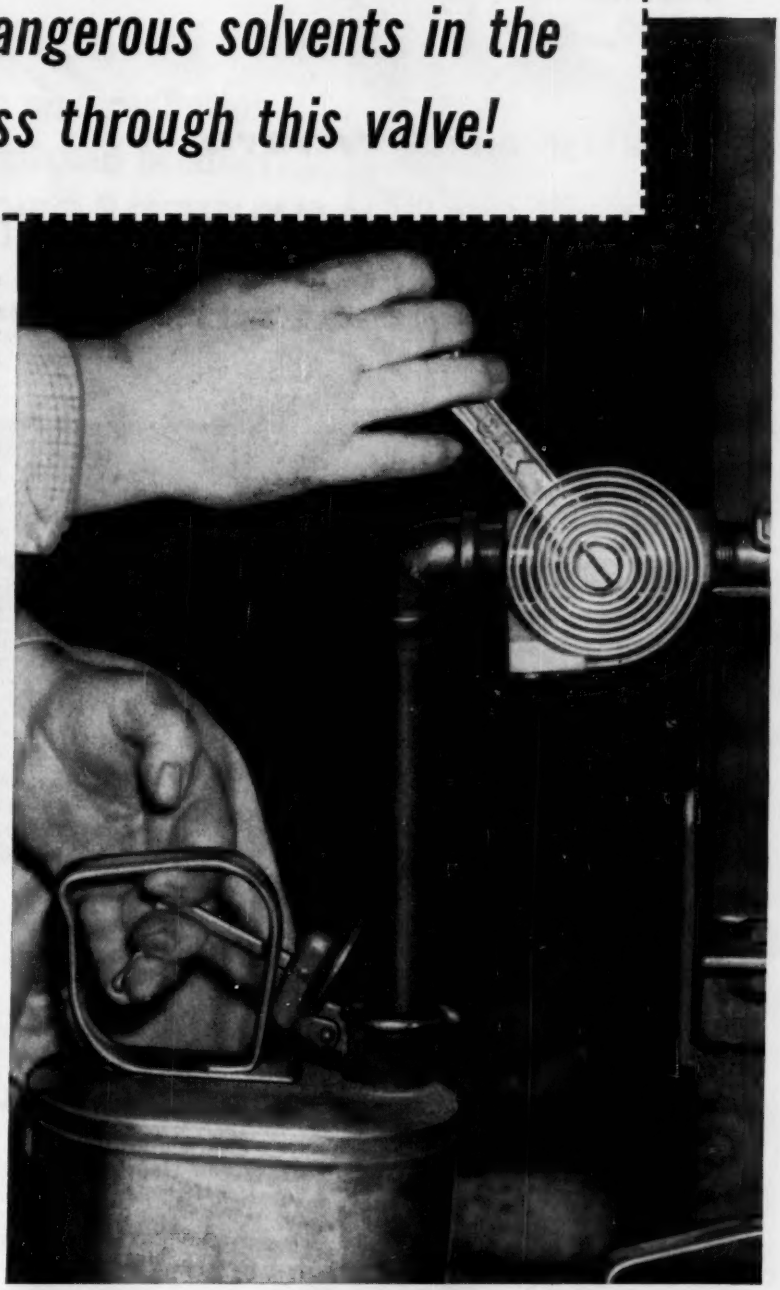
The Saran Lined Pipe was installed in 1953 and has been in continuous use since. Maintenance costs have been extremely low and I.R.C. engineers report that, during these six years, Saran Lined Pipe has performed dependably under their corrosive operating conditions.

Whenever dependable piping systems are required, whatever the degree of corrosion or chemical activity, consider Saran Lined Pipe. Saran Lined Pipe, fittings, valves and pumps are available for systems operating from vacuum to 300 psi, from below zero to 200° F. They can easily be cut, fitted and modified in the field without special equipment. For more information, write Saran Lined Pipe Company, 2415 Burdette Avenue, Ferndale, Michigan, Dept. 2282AK11-14.

See "The Dow Hour of Great Mysteries" on TV

**THE DOW CHEMICAL COMPANY • MIDLAND, MICHIGAN**

# The most dangerous solvents in the world pass through this valve!



But it's a *safe* passage. The ROCKWOOD ¾" (Fig. 802) Self-Closing Ball Valve is designed for *smooth, leakproof* handling of highly flammable liquids. A Rockwood Exclusive!

Take a typical installation at an experimental station of one of the nation's largest chemical companies. Here 36 different solvents, ranging from acetone to xylene, are dispensed from bulk containers. All types of self-closing valves were tried and evaluated for this critical job. None equalled ROCKWOOD for positive performance.

Unique ROCKWOOD Full Round Flow design holds turbulence to an absolute minimum — keeps static at a low level. Flash potential is negligible, greatly reducing fire hazard. In addition, the exclusive "*Spring Pressure* Compensation" keeps ball and seat in snug contact — assures leakproof, dripless shut-off, compensates for wear. Bronze valve body and Teflon trim resist corrosion. After 11 months and 103,200 open-and-shut cycles the company reports: trouble-free operation since installation.

Be as safe and sure with your solvent handling. Send coupon for complete details on the ROCKWOOD Self-Closing Ball Valve. Tested and listed by Underwriters' Laboratories, Inc.

**ROCKWOOD BALL VALVES**

***FULL, ROUND FLOW***

*Distributors in all principal industrial areas*

**ROCKWOOD SPRINKLER DIVISION**
*of The Gamewell Company • Subsidiary of E. W. Bliss Company*
**265 Harlow Street, Worcester 5, Massachusetts**

**Please send me complete details on the ROCKWOOD ¾" (Fig. 802) Self-Closing Ball Valve.**

*Name* .....
*Title* .....
*Company* .....
*Street* .....
*City* ..... *Zone* ..... *State* .....

# Why and where

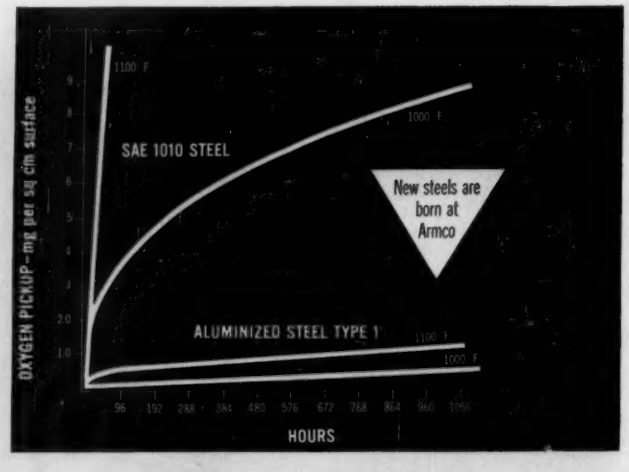
# Armco ALUMINIZED STEEL Type 1

## Resists heat and corrosion

Oxidation rates for ALUMINIZED STEEL Type 1 show why this special hot-dip aluminum-coated steel resists heat. The unique aluminum-on-steel material also effectively resists a combination of heat and corrosion, gives parts high strength and rigidity, and has high heat reflectivity.

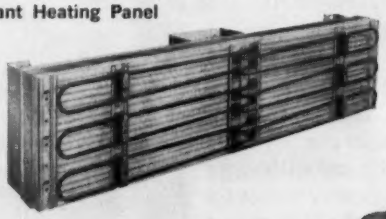
In chemical plant equipment such as burner shields, reactor covers, fume oxidizers, ductwork, radiant heating panels, ovens, and engine mufflers, Armco ALUMINIZED STEEL Type 1 is yielding longer service life than any other metal in its price class.

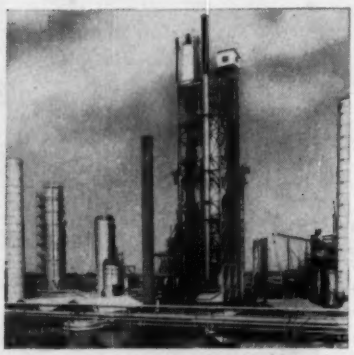
Perhaps *you* can save money or improve the processing equipment you make or use with Armco ALUMINIZED STEEL Type 1. It will pay you to get complete information on this special Armco Steel. Just write us. Armco Steel Corporation, 2590 Curtis Street, Middletown, Ohio.




Oxidation rates of ALUMINIZED STEEL Type 1 and SAE 1010 steel at 1000 F and 1100 F.

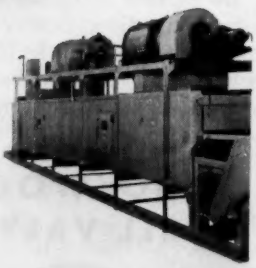
**Radiant Heating Panel**





**Stack Shield**

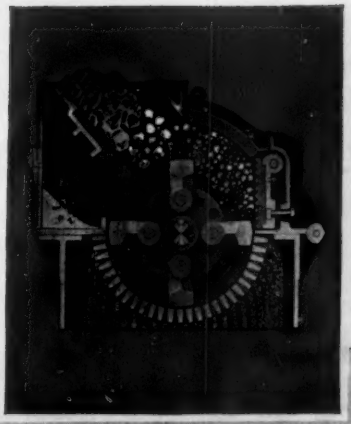
**Drying Oven**

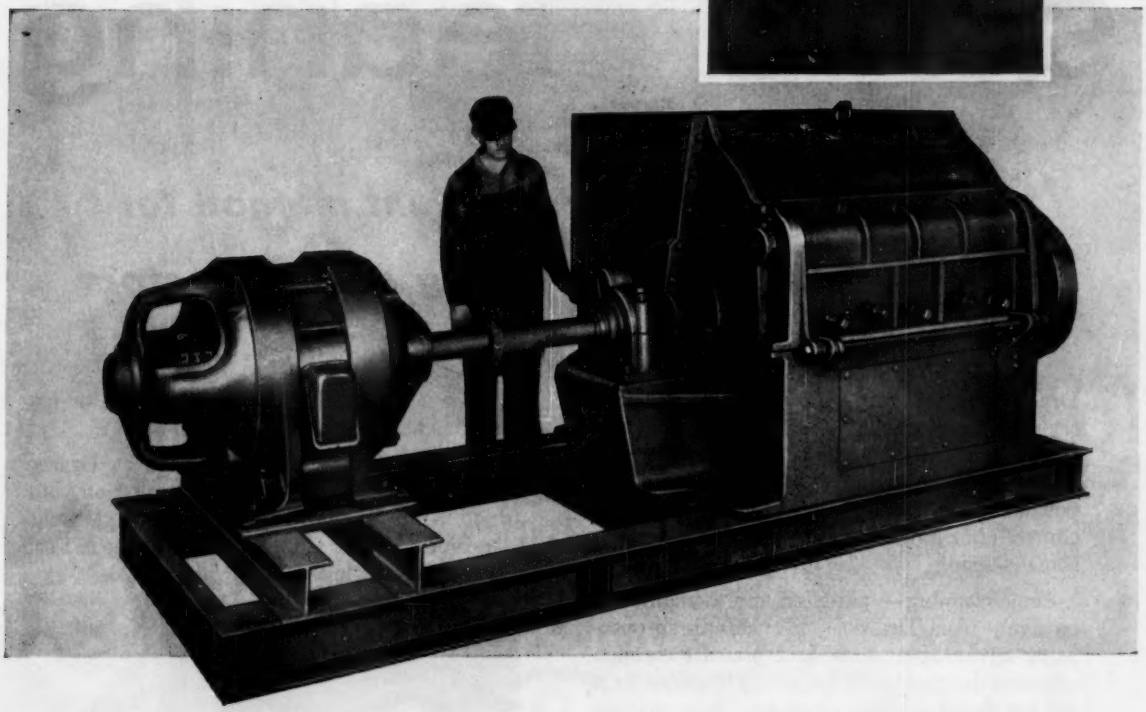


# ARMCO STEEL

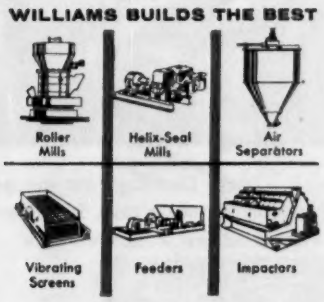
Armco Division • Sheffield Division • The National Supply Company • Armco Drainage & Metal Products, Inc. • The Armco International Corporation • Union Wire Rope Corporation

# Complete size reduction... from start to finished product... in a single Williams Hammer Mill





## Cut costs as much as 50% on production... up to 75% on equipment




In all normal crushing operations, a Williams heavy duty hammer mill can take most material and, *in a single pass*, reduce it to finished size! Production economies alone, in labor, power, maintenance, as well as stepped up output of better quality and more uniform products, will *cut costs up to 50%*.

Savings in original installations, *as high as 75%*, can also be expected. By making primary and secondary crushers unnecessary, a Williams hammer mill will eliminate all extra conveyors, drives, other equipment, special foundations and additional housing.

Williams hammer mills are built for daily rough and rugged service. Extra heavy manganese steel liners and breaker plates, oversize shafts, massive parts and reinforcements, all defy shock and wear, reduce downtime and replacements to nil.

If the cost price squeeze is one of your problems, get the facts about Williams hammer mills. *Write now for catalog.*

**WILLIAMS**
CRUSHERS GRINDERS SHREDDERS

*Oldest and Largest Manufacturers of Hammer Mills in the World*

**PATENT CRUSHER & PULVERIZER CO.**
2706 N. 9th St. St. Louis 6, Mo.

## ONLY DRACCO CAN OFFER

# sonic cleaning

(patented)

### the most modern and efficient method for removing dust from cloth-bag dust collectors

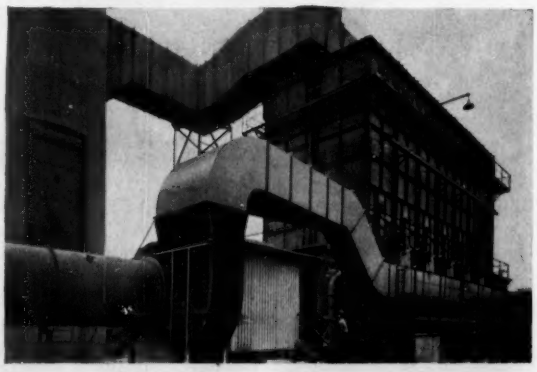
Dracco dust collectors now utilize one of industry's most exciting new techniques — *sonics* — to realize greatly improved filter bag cleaning action. This development is so significant that you should not specify or buy another dust control unit until you get the full story on sonic cleaning.

Sonic cleaning — patented and available exclusively from Dracco — provides three operating advantages: *lower back pressure* through effective dust removal; *longer bag life* since bags are not flexed, creased or shaken; *lower maintenance* through elimination of moving parts within the collector.

Cleaning by low-frequency sound waves has been conclusively proved in full-scale field operations on both Glass-Bag Filters and on conventional baghouses using cotton and synthetic bags.

Sonic cleaning is recommended for cement mill applications (kilns, grinding, classifying, materials handling), electric and open hearth steel furnaces, metallurgical furnaces, rock dryers, calciners, fusing furnaces, chemical processes and related applications. You can use it wherever mechanical shaking is undesirable or unsuitable and eliminate the shakers.

You can get further information on Dracco sonic cleaning and expert consultation on your dust control requirements from: Dracco Division of Fuller Co., Harvard Avenue & East 116th Street, Cleveland 5, Ohio.

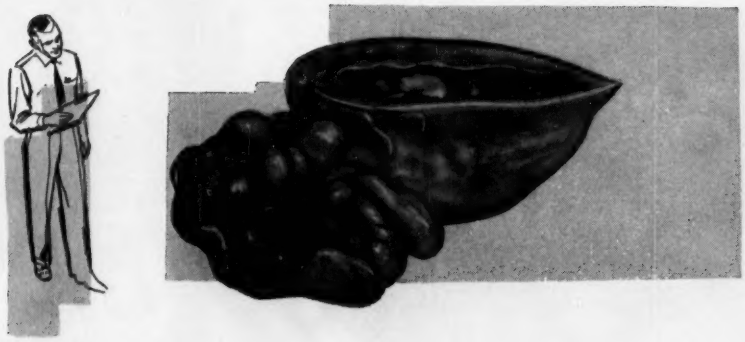


**Proved in service** — Dracco Glass-Bag Filter equipped with sonic generators cleans cement kiln gases. Sound waves dislodge collected dust without wear or fracture of cloth.

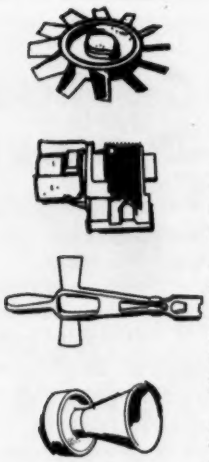
**DRACCO** *airstream* conveyors
dust control equipment

FULLER COMPANY GENERAL

**intricacy • smoothness • soundness**



## only a Wauke-Sha Ceramic-Type Casting can duplicate the intricacy, smooth finish, soundness ...to absolute tolerances...in unlimited size



- intricate parts with no costly machining
- hairline reproduction of detail
- no cracking or tearing
- no porosity, internal voids, cracks
- no surface gas holes, blemishes, non-metallic inclusions

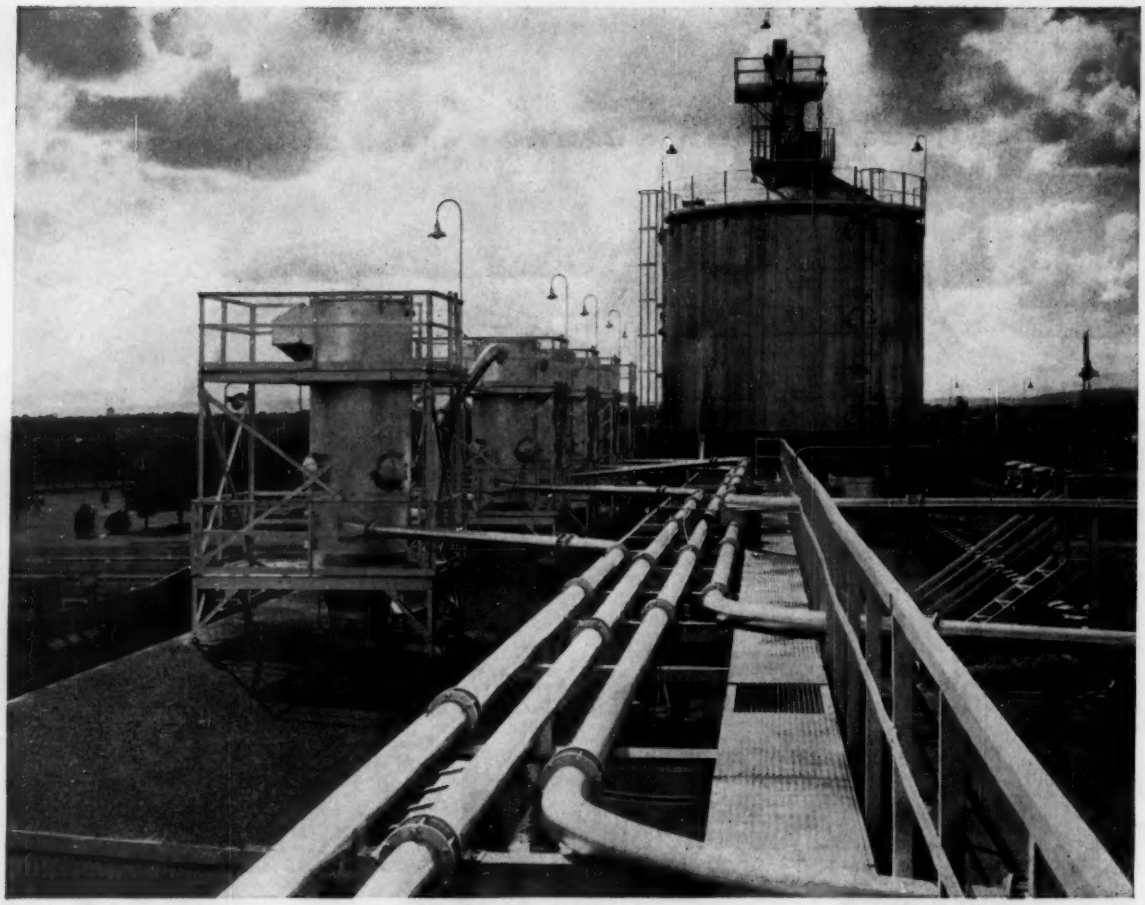
Absolute dimensional accuracy plus greatly increased heat and stress resistance are critical to today's intricate designs. Wauke-Sha process will provide low-cost castings to fill these demands . . . castings which are, in many cases, more accurate than machining, with "as cast" dimensional tolerances of ±.005" per inch.

Full design flexibility is a major advantage of this newly developed casting technique. Thin-wall designs require no expensive machining; no fear of voids with light and heavy adjacent sections.

*For further information on Wauke-Sha Ceramic Type Castings write:*

Waukesha Foundry Company

**Dept. F-S1, Waukesha Foundry Co., Waukesha, Wis.**



# FULLER PNEUMATIC CONVEYING SYSTEMS INCREASE PRODUCTION, CUT CONTAMINATION FOR GOODYEAR

Recent installation of specially engineered Fuller Airveyor® pneumatic conveying systems to handle pelletized rubber has helped Goodyear Tire and Rubber Company increase production. These systems are the latest Fuller design resulting from over 15 years experience in pneumatic conveying of rubber pellets. These completely enclosed automatic systems virtually eliminate contamination problems and greatly reduce the chance of loss due to spoilage.

Automated handling of crude rubber with Fuller Pneumatic Conveying Systems, in place of conventional rubber slab sheeting on a mill, is the key. One Airveyor system conveys the pelletized rubber from the pelletizer to a weigh station, a distance of 500 feet. Four more systems operate from the sink dump scales to inlet spouts of the finish-run Banburys.

All of these Airveyor pneumatic conveyors are of the vacuum type, employing positive pressure exhausters for air supply. Each conveying system is equipped with its own individual bag-type filter, automatic in operation, which provides for 100% visible dust retention. Exhausters and filters are located on the roof. A control panel permits manual or automatic operation of the entire handling system.

If you are handling dry, bulk, granular materials, a Fuller Conveying System application-engineered to your process can be equally advantageous. Look to Fuller, whose range of products coupled with experienced know-how offers you the best *single source* for solving pneumatic materials handling problems. Just call or write Fuller today outlining your problem—no obligation, of course. A-288 1954

FOR DETAILS ON FULLER PRODUCTION LINE, SEE CHEMICAL ENGINEERING CATALOG

FULLER COMPANY GENERAL AMERICAN TRADE MARK

**FULLER COMPANY**
**134 Bridge St., Catasauqua, Pa.**
Subsidiary of General American Transportation Corporation
Offices in Principal Cities Throughout the World

**Fuller**
...pioneers in harnessing AIR

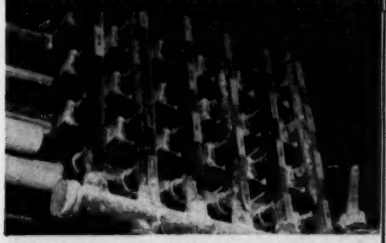
# DESIGNED FOR MODERN PIPING!




ILLUSTRATED:
1" SIZE
SIZE RANGE:
¼" TO 6"

## THE ECON-O-MISER BALL VALVE

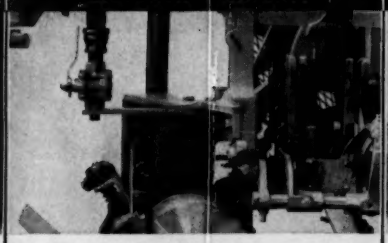
### COMPACT PIPING LAYOUT



Here are 19 Econ-O-Miser Ball Valves compactly installed on this paint blending manifold. Note the absence of unions . . . this valve is both a valve and a union! The Econ-O-Miser is smaller, easier to install . . . just right for modern piping layouts, where equipment must fit into tight areas.

Let us show you . . . in your own plant! Write us about your limited space problems!

### DIFFICULT MEDIA



The Econ-O-Miser Ball Valve successfully controls the flow of cold glue with a viscosity of molasses, on the WORLD Tandem Labeler manufactured by Economic Machinery Co. Clean wiping action, positive leakproof shut-off, and smooth round flow, make the Econ-O-Miser ideal for handling difficult media.

Let us show you . . . in your own plant! Write us about your media problems!

### TROUBLE-FREE OPERATION



Outdoor propane and butane storage tanks in remote field processing plants require dependable positive shut-off valves on bleed lines. The unique features of the Econ-O-Miser Ball Valve provided the practical answer . . . no lubrication . . . no metal-to-metal contact . . . quick visual ON-OFF indication . . . trouble-free service.

Let us show you . . . on your outdoor applications! Write us about your valve maintenance problems!

**COMPARE . . . THE ECON-O-MISER BALL VALVE**

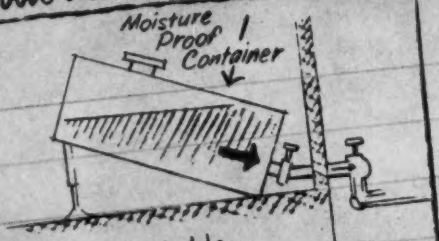
NO UNION NECESSARY



**WORCESTER VALVE CO., INC.**

16 PARKER STREET, WORCESTER, MASS.

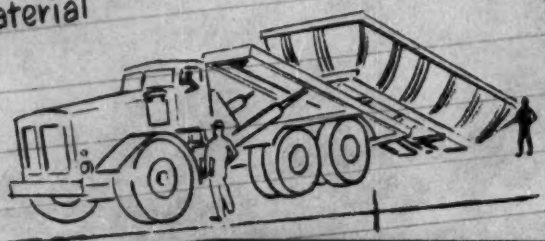
## Materials Handling Ideas with the Dempster Dinosaur




Use as a portable Hopper for temporary storage of wet or dry material

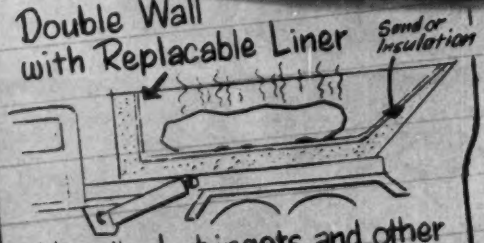


Use as a portable cable reel station - or for handling rolls of paper or steel

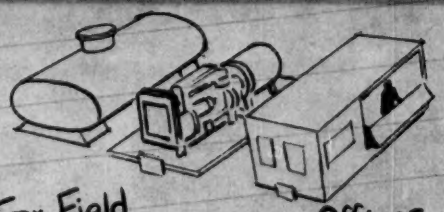


Shift heavy in-plant movements from rails to rubber with Dinosaur and 100,000 lb. capacity trucks... For slag... ingots... stone or chemicals.

Double Wall with Replacable Liner




Handle hot ingots and other materials with insulated containers.



For Field Operations Portable Offices, Tool Sheds, Generators, Fuel Tanks, Compressors etc. can be moved to the site by the Dinosaur.

DEMPSTER BROTHERS offers a New Dinosaur Brochure, Free on Request

**DEMPSTER BROTHERS**
Inc.
Knoxville 17, Tenn. Dept. CE-11

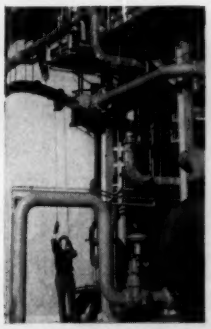






The DEMPSTER DINOSAUR®

# *Gaskets exposed to harsh chemicals, extreme temperatures demand the remarkable resistance properties of Armalon® felt*



If harsh chemicals and –320°F. to +550°F. temperatures force you to replace gaskets every few weeks, you need gaskets made of Du Pont "Armalon"* TFE-fluorocarbon resin-impregnated felt. This unique gasketing material gives months (even years!) longer service, can drastically cut replacement costs and work interruptions.

Just look at these remarkable examples of how "Armalon" felt gaskets extend service life under extreme operating conditions:

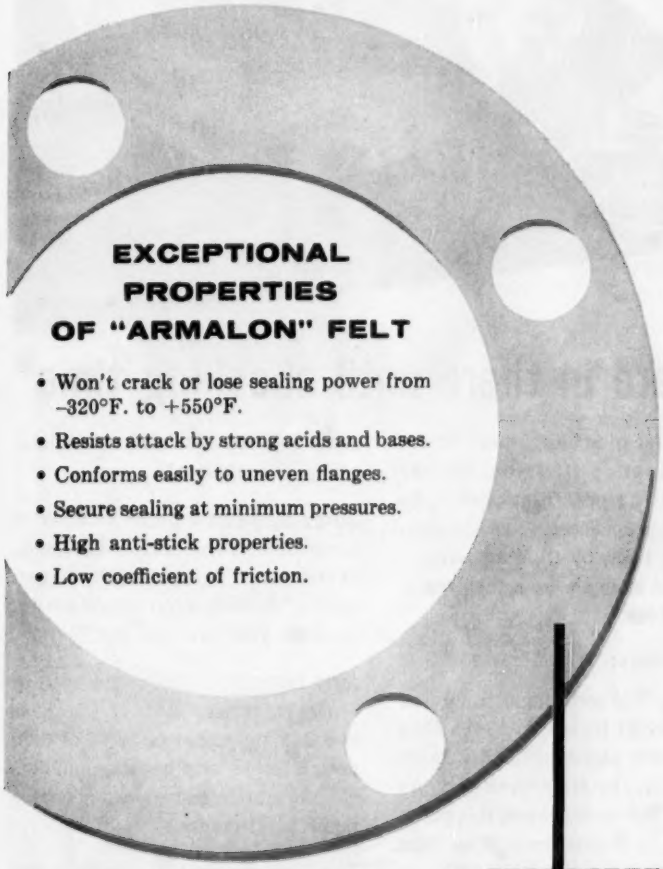
**Lasts over 700% longer!** "Armalon" gaskets handling 99.3% sulfuric acid at 200°C. are still in service after 18 months. Conventional materials frequently had to be replaced within a week.

**$HNO_3$ fumes at 170°C. and 97 psi.** were still satisfactorily carried in stainless-steel pipes gasketed with "Armalon" after 7 months. Other materials had to be replaced every 10 to 15 days.

**After 15 months,** ammonium sulfate and sulfonic acid are still being processed in a centrifuge containing a gasket of "Armalon".* Previous materials were replaced every two to three weeks.

These are just three of the many examples of exceptional performance of "Armalon" illustrated in the Du Pont booklet *"Armalon"—for gasketing under extreme conditions.* Send for your free copy and see how you can end troublesome gasketing problems. Clip coupon or write Du Pont . . . there's no obligation. E. I. du Pont de Nemours & Co. (Inc.), Fabrics Division, Wilmington 98, Delaware.

*"*Armalon" is Du Pont's registered trademark for its TFE-fluorocarbon-resin-impregnated felts.*







**FREE BOOKLET** tells you how you can reduce gasketing costs . . .

E. I. du Pont de Nemours & Co. (Inc.)
Fabrics Division, Dept. CE-11, Wilmington 98, Delaware

Please send me a free copy of *"Armalon"—for gasketing under extreme conditions.*

Name_____ Position_____

Company_____

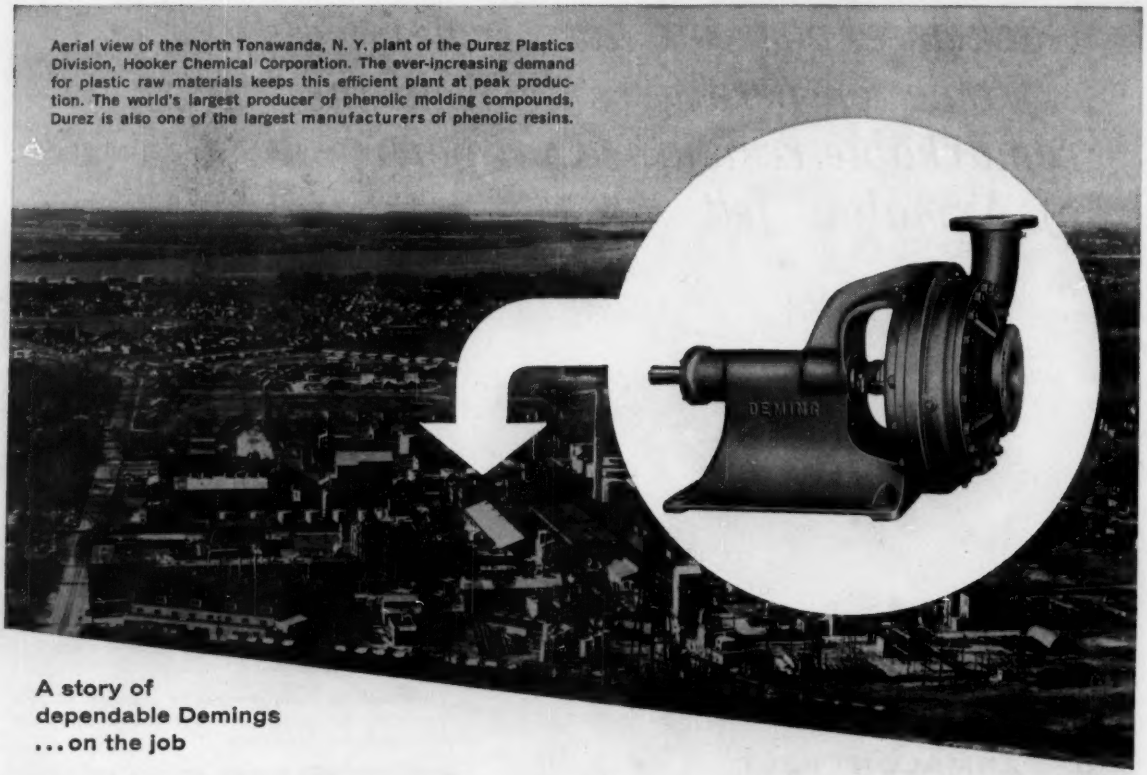
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**DU PONT INDUSTRIAL COATED FABRICS**

DU PONT
REG. U. S. PAT. OFF.

BETTER THINGS FOR BETTER LIVING THROUGH CHEMISTRY




Aerial view of the North Tonawanda, N. Y. plant of the Durez Plastics Division, Hooker Chemical Corporation. The ever-increasing demand for plastic raw materials keeps this efficient plant at peak production. The world's largest producer of phenolic molding compounds, Durez is also one of the largest manufacturers of phenolic resins.

**A story of dependable Demings ...on the job**

# "We forget the pumps are in there until checking time"

| MAINTENANCE RECORD | |
|---|---|
| YEAR | SERVICE |
| 1940 | none |
| 1941 | none |
| 1942 | none |
| 1943 | none |
| 1944 | none |
| 1945 | none |
| 1946 | none |
| 1947 | none |
| 1948 | none |
| 1949 | none |
| 1950 | none |
| 1951 | none |
| 1952 | none |
| 1953 | none |
| 1954 | none |
| 1955 | repacked glands |
| 1956 | none |
| 1957 | none |
| 1958 | none |
| 1959 | none |
| 1960 | none |

That's what plant engineers at the Durez Plastics Division, Hooker Chemical Corporation, cheerfully remarked when asked about the service given them by Deming pumps. Here is an example from their maintenance files.

**Case History:**

A Deming 2½" centrifugal pump was installed at Durez in 1940. This dependable pump performs daily, moving styrene from tank cars. As shown in the record at left, this pump received no maintenance other than repacking of the glands in 1955.

Another dependable Deming centrifugal, bought and installed in 1944, pumps phenol – the basic material of this major plastic manufacturer. Other than being checked and cleaned at regular intervals, this pump has had absolutely no maintenance or downtime!

Durez also has a great number of sump pumps in service. George E. Patterson, Engineering Manager, reports, "Deming sump pumps are not touched, year in – year out."

Jerry Linneman, Durez Maintenance Engineer, states, "Here at Durez we like Deming pumps because of their design, price, and because our efficient operation demands dependable pump performance."

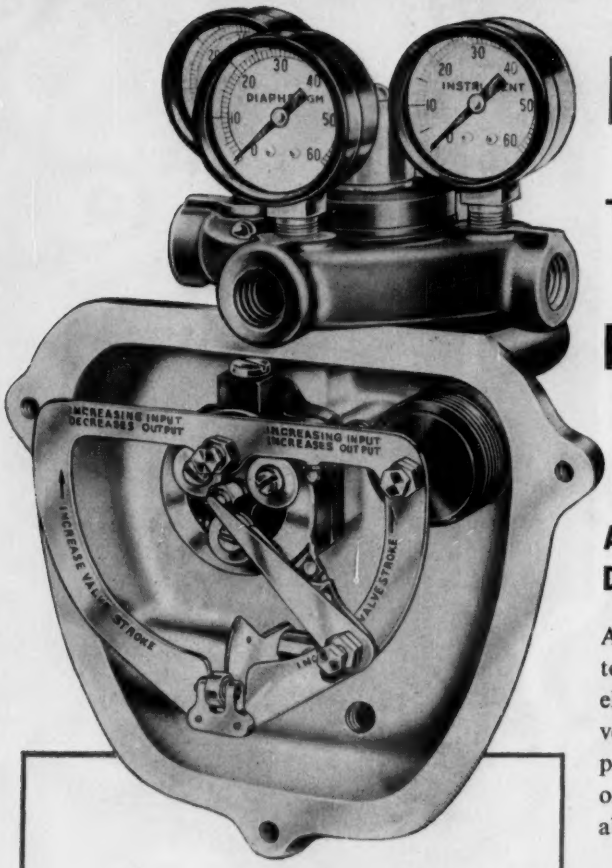
This type of low maintenance and superior service can be yours by simply specifying Deming on your next pump order.

Send today for Catalog E, it will give you complete information on Deming's extensive line of industrial pumps.

**The DEMING Company**

1187 BROADWAY • SALEM, OHIO

***A new concept in design makes possible the...***




# FISHER

## TYPE 3560 VALVE POSITIONER

V/P

### Assured product performance through DYNAMIC ANALYSIS engineering

Application of mathematical techniques of design to pressure control systems has enabled Fisher to eliminate the conventional approach in the development of the new V/P valve positioner. It has provided the V/P with the following combination of characteristics and performance . . . unobtainable in any other type of valve positioner.

**SMALL AND COMPACT** . . . only 6⅝" wide and 8¾" high (with gauges).

**CONVENIENT ADJUSTMENT** . . . valve stroke and zero adjustment readily accessible and easy to make.

**SPLIT RANGE** . . . no parts change whatsoever is required for split range operation.

**EASILY REVERSIBLE** . . . reversed by simply moving flapper arm from one beam quadrant to the opposite quadrant.

**CHARACTERIZED CAMS** . . . offer wide flexibility in valve characteristics.



**PERFORMANCE DATA**

| | |
|---|---|
| Hysteresis, (Average) | 0.0012" |
| Linearity | as required. Change cams to obtain desired characteristics |
| Sensitivity | 0.14 psi |
| Resolution Sensitivity | 0.002 psi |
| Repeatability | ±0.0003" |
| Stroking Speed | 0.37 in/sec. |
| Air Consumption | 10 scfh |
| Break Frequency (5% of instrument pressure range) | 3.9 cps |
| Break Frequency (3% of instrument pressure range) | 4.6 cps |

The above performance data was taken from laboratory tests on a Type 657 diaphragm actuator, Size 40, with 1½" travel. Instrument range 3 to 15 psi.

***Write today for Bulletin E-3560***

IF IT FLOWS THROUGH PIPE ANYWHERE IN THE WORLD . . . CHANCES ARE IT'S CONTROLLED BY . . .

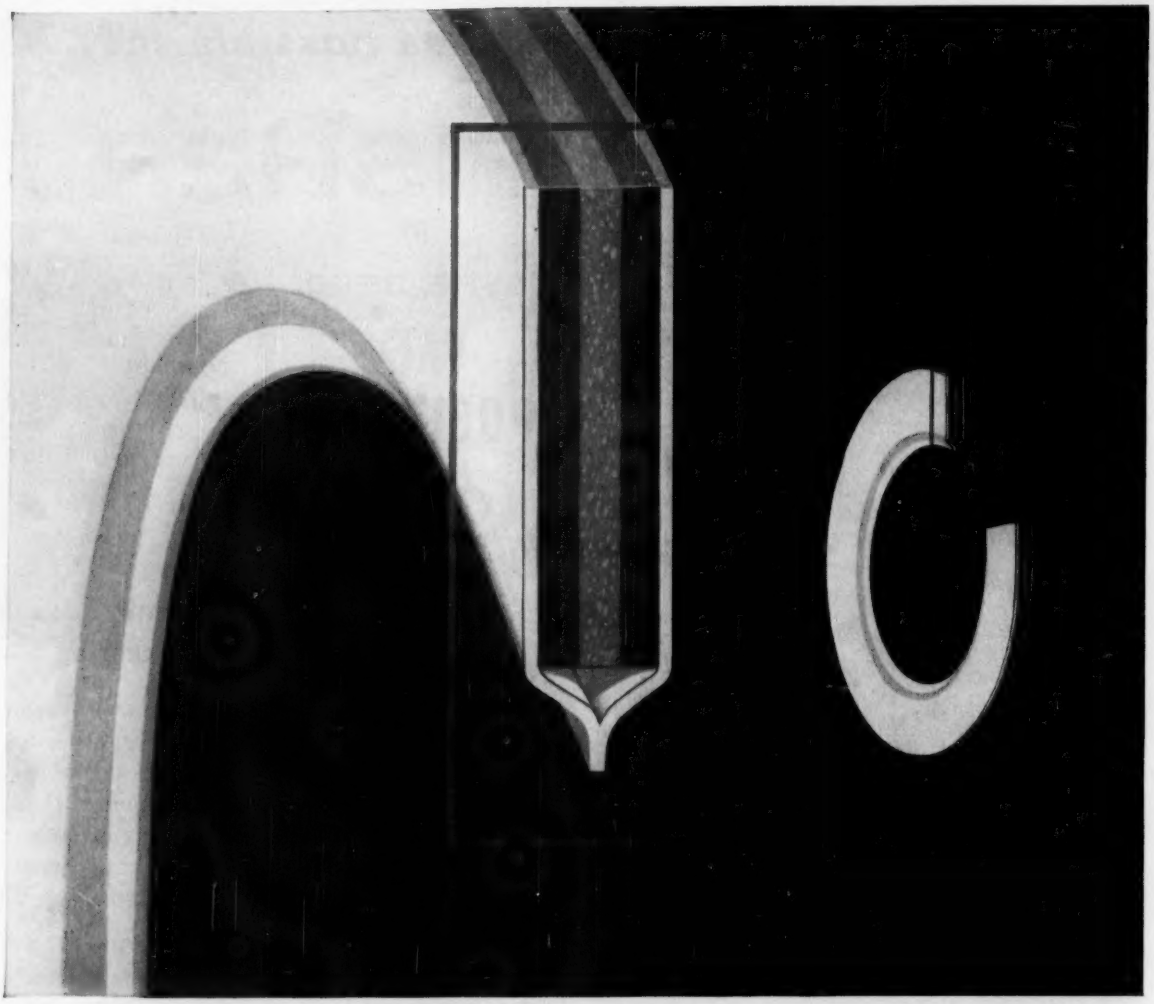
**FISHER GOVERNOR COMPANY**

*Marshalltown, Iowa / Woodstock, Ontario / Rochester, England*

BUTTERFLY VALVE DIVISION: CONTINENTAL EQUIPMENT COMPANY, CORAOPOLIS, PA.

FISHER® Controls

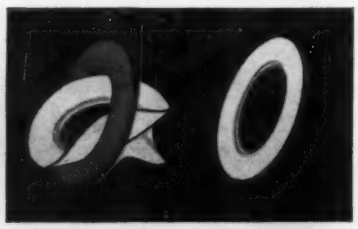
SINCE 1880



# Rely on the gaskets especially designed to handle corrosives, even in glass-lined equipment!

**J-M CHEMPAC® GASKETS COMBINE ASBESTOS AND TEFLON FOR LONGER SERVICE PER DOLLAR INVESTED**

Here's the gasket that can scoff at active chemicals and solvents. That's because the envelope-type design combines the protection of both compressed asbestos filler and Du Pont Teflon.

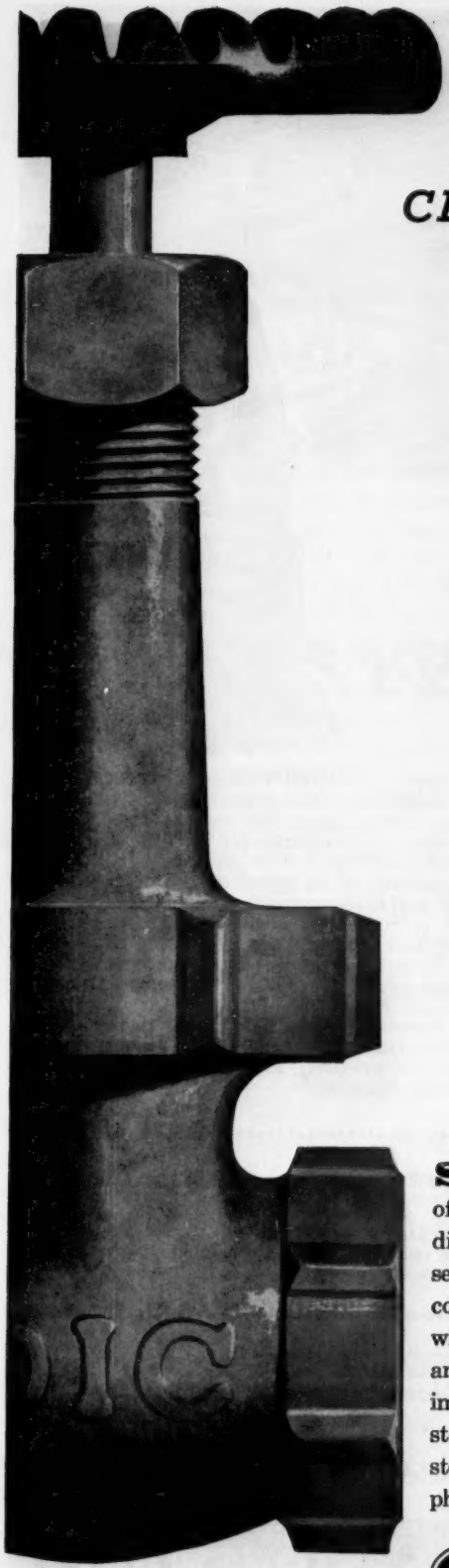


A center core of compressed Chrysotile Asbestos is sandwiched between two layers of felted Blue Asbestos. These three asbestos layers provide longer life . . . outstanding corrosion and heat resistance . . . and the "cushion" effect so desirable in glass-lined equipment. A split or welded envelope of electrical-grade Teflon is then added for even greater corrosion resistance.

Chempac Gaskets are soft, conformable and effect a seal at low bolting. Available in pipe sizes from ½" to 12" as standard. Other J-M envelope-type gaskets are also available in various sizes and with special fillers for specific requirements.

It will pay you to solve your corrosive sealing problems with Chempac Gaskets—*especially designed* for that purpose. You can rely on them to give you the most effective sealing . . . and longest, most economical service per dollar invested. See your J-M Distributor. Or write to Johns-Manville, Box 14, New York 16, N. Y. In Canada: Port Credit, Ont. Ask for Chempac Book, PK-124 A.

JOHNS-MANVILLE



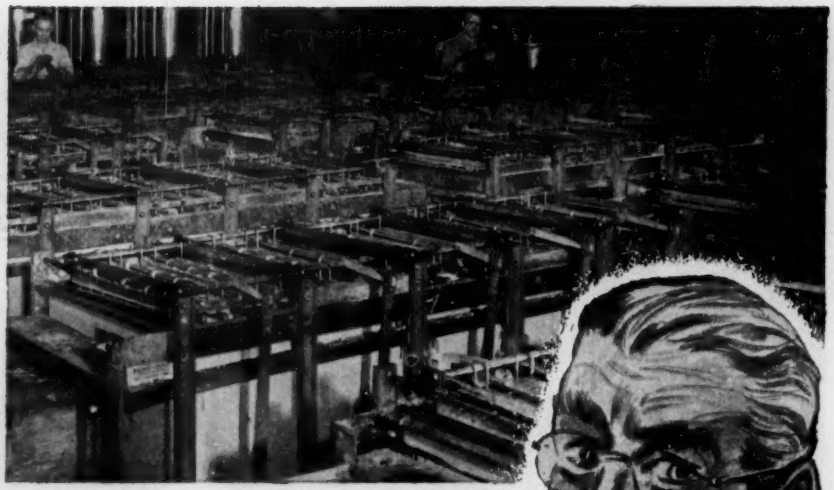

## *CHECK OIC FIRST...IT PAYS!*

**SERVICE** to meet your valve needs is the "specialty of the house" at your nearby OIC Valve Distributor. As a first-line distributor, he gets OIC's all-out support to insure that you get the service you deserve. OIC's strategically located warehouses, and complete-line factory inventory "backstop" every OIC distributor with a multi-million dollar stock of bronze, iron, ductile iron, cast and forged steel valves. As a result of this strong distributor support, immediate delivery of the more popular items out of distributor's stock is common, and 4 to 5-day delivery out of warehouse or factory stock is routine. When quality is a problem, or delivery is urgent, phone your OIC distributor. Service is his business, and ours.

OIC VALVES

FORGED AND CAST STEEL, BRONZE, IRON AND DUCTILE IRON VALVES

THE OHIO INJECTOR COMPANY • WADSWORTH, OHIO



# How can you be SURE that your Tank Linings are MATCHED TO YOUR NEEDS?



Tank lining failures can be mighty expensive in terms of ruined tanks and disrupted production schedules. That's why low cost linings sometimes prove to be the most expensive in the long run.

On the other hand, the extra money spent for protection that's not needed would be better invested elsewhere in the plant.

Selection of the proper tank lining material is frequently a confusing job for the man who's not an expert. The best course is to follow two simple, logical rules:

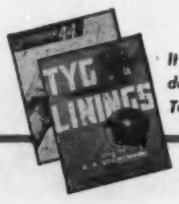
**1. *Draw on the experience of a tank lining specialist.*** One of The U. S. Stoneware Company's fully experienced tank lining engineers . . . who works day-in and day-out with tank lining problems of all types . . . will be pleased to analyze your application; weigh such variables as operating temperatures, corrosive conditions, abrasion resistance requirements, tank construction, and the like; and recommend the one tank lining material that will be best for your job — all without cost or obligation.

**2. *Work out your needs with a firm offering a full line of tank lining materials.*** Whatever your tank lining problem, The U. S. Stoneware Company produces a material that *exactly* fits your needs: TYGON® modified polyvinyl chloride extruded sheet lining, providing outstanding chemical resistance at temperatures up to 165° F.; KEL-F* trifluorochlorethylene plastic, completely inert to corrosives of all types up to 350° F. (and higher with acid brick oversheathing); PENTON** chlorinated polyether extruded lining, resistant to all alkalies and acids except fuming nitric and fuming sulfuric, at elevated operating temperatures in the range between polyvinyl chloride and the fluorocarbons; RESILON depolymerized rubber-and-resin-based thermoplastic, available either plain or fiberglass-reinforced; ACIKOTE synthetic resin baked-on coating; and others with more specialized applications.

257-G

If you'd like help on a lining problem, simply outline your operation in a letter to The U. S. Stoneware Company. A "U. S." Tank Lining Specialist will be glad to make suggestions and recommendations without cost or obligation.

*Registered Trade Mark, 3M Co.
**Registered Trade Mark, Hercules Powder Co.




*It will pay you to investigate! Write today for complete information on "U. S." Tank Linings!*

PROCESS EQUIPMENT DIVISION

**U. S. STONEWARE**
AKRON 9, OHIO

Top news stories and what they mean to CPI technical decision makers

# Chementator

## Anodic protection's major job: reduce process contamination

Originally envisioned as a dollar-saving device to prevent corrosion (*Chementator*, Nov. 16, 1959, p. 87), Continental Oil's anodic protection system (Anotrol) may find its immediate major application not in severely corrosive situations but in protecting products against iron contamination.

At a recent meeting in Baltimore, sponsored by Conoco and Minneapolis-Honeywell (who will market the system under license), *CE* learned that Conoco is eyeing applications in manufacture of detergents, rayon, pharmaceuticals and synthetic fibers to reduce iron pickup. Anotrol can also reduce contamination in tank-car and tank-truck shipments, and in cooling water circulating through nuclear reactors.

Meanwhile, in Lake Charles, La., Conoco says that it is considering using the Anotrol system in its own Alfol (straight-chain alcohols) plant now under construction there. Anodic protection of equipment used in a hydrolysis step involving sulfuric acid would let Conoco substitute carbon steel for stainless and still prevent product discoloration caused by iron pickup.

## Key to Shell's isoprene process: simultaneous production of butadiene

Much of the mystery surrounding Shell Chemical's isoprene process has been swept away by publication of Australian patent 57,725. According to this Shell patent, the secret of making isoprene economically is simultaneous dehydrogenation of butylene along with isoamylene to make butadiene as coproduct—furnishing the raw material for polybutadiene, which can be used as an extender for polyisoprene.

Success of Shell's commercial version of this process is attested by the fact that it has just expanded its Torrance, Calif., facility to 40 million lb./yr. and is building an 80-million-lb./yr. plant near Marietta, Ohio. Little has been known previously about the process other than it centers around dehydrogenation of isoamylene (*Chementator*, Mar. 7, p. 51). Shell will not confirm that the patent describes its commercial process, but the patent's features tally with what is known about Shell's operation.

To start the patented process, butane is dehydrogenated over chromium oxide catalyst followed by two-stage extractive distillation with aqueous acetonitrile, to recover butylene and product butadiene. The butylene stream mixes with isoamylene and feeds to vapor-phase reactors where dehydrogenation takes place over iron-oxide catalyst promoted with chromium oxide and potassium carbonate. Reactor pressure is about 10 psig., temperature about 1,100 F. Conversion of butylene to butadiene is about 25% and isoamylene to isoprene is about 35.5%.

Reactor effluent flows to a stripper-scrubber which removes polymeric materials in recycled oil. Vapor leaving top of scrubber is dehydrated and compressed to 105 psig., which condenses isoprene and butadiene while light gases separate. Liquid stream feeds to a depropanizer and then to a fractionator that splits out a butylene-butadiene stream overhead and isoamylene-isoprene as bottoms.

The butylene-butadiene stream feeds back to the extractive distillation unit in the feed preparation section while the isoprene is separated from the isoamylene by further distillation.

## Any metal gets corrosion protection from new chromium coating system

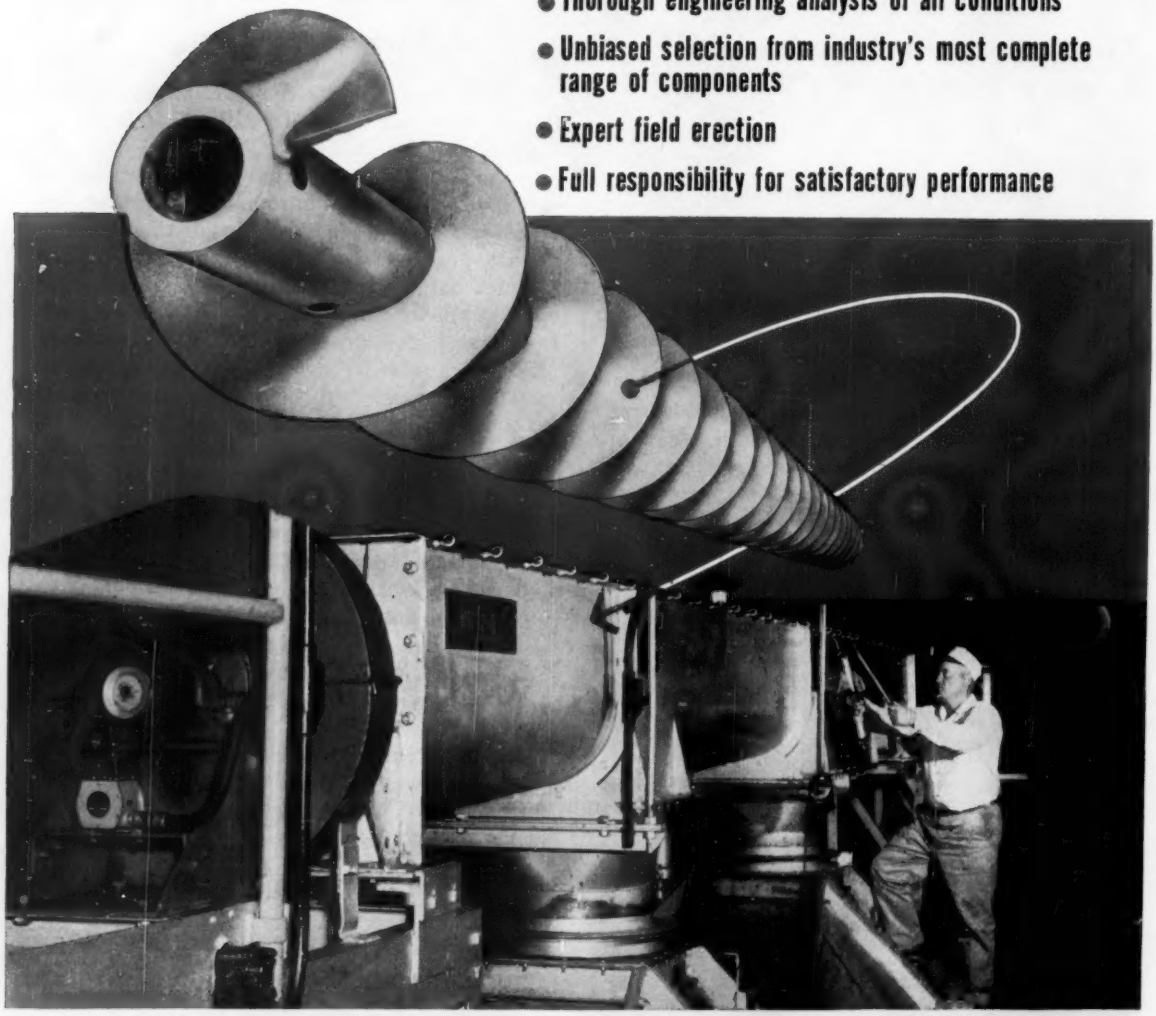
Pennsalt Chemicals Co. is readying for commercial development a new coating system that covers all types of metals with a clear or colored corrosion-resistant film. Of particular interest to the chemical industry may be use of the new technique to apply base coats to aluminum and stainless steel over which conventional coatings can then be applied.

Called the Hinac process, method deposits coatings consisting mainly of chromium compounds that are claimed to have excellent resist-

*Here's why a Link-Belt engineered screw conveyor installation means*

# a better-working system ...less work for you

- Thorough engineering analysis of all conditions
- Unbiased selection from industry's most complete range of components
- Expert field erection
- Full responsibility for satisfactory performance



FROM design of equipment to operation, you leave nothing to chance when you leave everything to Link-Belt's complete screw conveyor service. Whatever your needs, Link-Belt can engineer a system to meet them exactly . . . if desired, will handle entire erection and accept full responsibility for placing your system in operation.

Included in Link-Belt's full line of components are 17 basic screw designs, available in a variety of metals. Each offers Link-Belt's exclusive Quik-Link feature that permits fast, easy removal of any conveyor screw section or hanger without disturbing other components. An equally complete line of troughs, ball and babbitted bearing hangers, trough ends with ball bearing flange blocks and trough end seals, couplings, gates, spouts, and drives makes Link-Belt your convenient, one-source supplier for all your requirements. Ask your nearest Link-Belt office for Data Book

**LINK-BELT**

14,707

**SCREW CONVEYOR EQUIPMENT**

**LINK-BELT COMPANY:** Executive Offices, Prudential Plaza, Chicago 1. To Serve Industry There Are Link-Belt Plants, Warehouses, District Sales Offices and Stock Carrying Distributors in All Principal Cities. Export Office, New York 7; Australia, Marrickville (Sydney); Brazil, Sao Paulo; Canada, Scarboro (Toronto 13); South Africa, Springs. Representatives Throughout the World.

ance to most acids, alkalis, solvents and oxidizers. Unlike conventional coatings, however, Hinac films are thin (about 0.000006 in. thick) and thus can be scratched. Parts treated in this fashion cannot be subjected to heavy abrasive service.

Pennsalt hopes to find a major market for these coatings in aluminum building panels. Hinac coatings come in a variety of colors and are said to provide a weather-resistant surface cheaper than anodizing. Too, parts for automobiles, household appliances and furniture that don't see heavy service can be given either a clear or a colored protective film.

Hinac coatings will be marketed in 5-gal. and 55-gal. drums. These solutions are then blended with proper amounts of water and applied by dipping, rolling or spraying. Coated metal must then be heated to 350-425 F. to cure the coating; curing time is as short as a few seconds. No cost data are yet available on Hinac coatings.

---

*A new concentrated fertilizer—potassium nitrate—will be made in a $7-million plant being built at Vicksburg, Tenn., by Jacobs Engineering for American Metal Climax. Plant will nitrate KCl with nitric acid, making chlorine as a byproduct. Anhydrous $HNO_3$ and nitrogen tetroxide may also be made if demands warrants.*

---

## Two gas sweetening processes are getting commercial tryouts

The past year has seen a host of new gas sweetening processes appear; now add two more to the growing list. *CE*'s London bureau reports that England's North Western Gas Board and the Clayton Aniline Co. have developed an $H_2S$-removal flowsheet they are calling the Stretford process. And Kansas City consultant A. G. Eickmeyer has come up with an acid-gas absorption flowsheet dubbed the Catacarb process that has landed its first commercial assignment at an unidentified installation in the Southwest.

The Stretford process is already operating at two NWGB works and will shortly be used in a third. Process is built around two new liquid absorbents that are byproducts of anthraquinone production: sodium salts of 2-6 and 2-7 anthraquinone disulfonic acids. Process is claimed to cost only 33-66% as much as conventional iron-oxide purification systems that are widely used.

Gas to be treated contacts the anthraquinone acids in a packed tower. Solution from bottom of tower containing dissolved $H_2S$ passes to a reaction tank where it is held long enough for the carbonyl groups to react with the $H_2S$ to form free sulfur and the corresponding hydroquinone. A rotary vacuum filter removes the sulfur from solution and the filtrate passes through an oxidation tower where injected air oxidizes the hydroquinone back to the original quinone, ready for another absorption cycle. Patents have been applied for and six British firms are licensed to sell the process; other applicants for licenses would be "welcomed."

Eickmeyer's Catacarb process removes $CO_2$ in addition to $H_2S$, resembles the Giammarco-Vetrocoke flowsheet (*Chem. Eng.*, Sept. 19, pp. 166-169) in some respects except that it uses "nonpoisonous catalysts." The commercial Catacarb unit was converted from an existing system, is said to be treating a greater volume of gas than the old unit with lower utility consumption. Other Catacarb plants are under contract.

---

## Newsprint from bagasse via unique pulp blending technique

Crown-Zellerbach, San Francisco, says that it has developed an improved process for making newsprint from bagasse—the stalk residue left from sugar cane processing. Advantages claimed for the new route: pulp produced has strength and printing performance equal to wood-derived pulp and can be run on standard papermaking equipment.

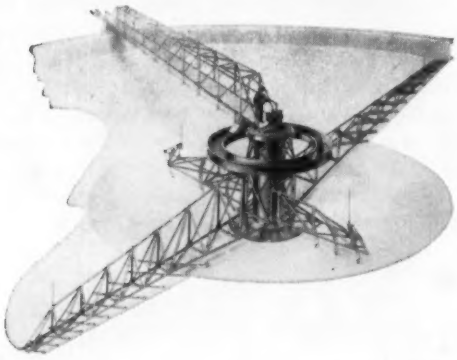
Technique has been developed in cooperation with the Hawaiian Sugar Planters Assn. and tested on a commercial scale in one of C-Z's northwest pulp mills. Process has been licensed to Sahu Jain, Ltd., Calcutta, India, which is building a newsprint plant 22 mi. from Bombay. Route may also be used in Hawaii's first pulp mill, now under consideration.

Few details are available on the process. All that is known is that the furnish to the papermaking machine is a mixture of chemically and mechanically refined bagasse pulp; the mechanical pulp is produced in a disk refiner. This pulp mixture is said to overcome the drawbacks possessed by mechanical and chemical pulps individually.

*(Continued on page 106)*

# Process Trends from DORR-OLIVER

## NEW DEVELOPMENTS IN SEDIMENTATION INVITE APPRAISAL



The technique of separation by sedimentation may be employed to produce a more or less clear liquor from a mixture of solids and liquid (clarification), or to concentrate suspended solids into a denser slurry (thickening). It may also be adapted to give fractional separation of particles of various sizes or specific gravities (hydro-separation).

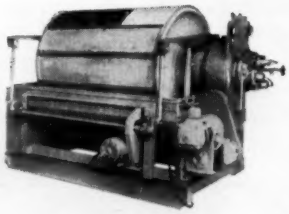
Modern continuous sedimentation systems, which substitute mechanical means for the old batch methods of slow gravity settling and decanting, date from the invention of the Dorr Thickener in the early 1900's. Developments such as multiple compartments and hinged rake arms, flocculation to promote economical handling of colloidal materials, and the combination of several operations within a single tank, have continually expanded scope and versatility.

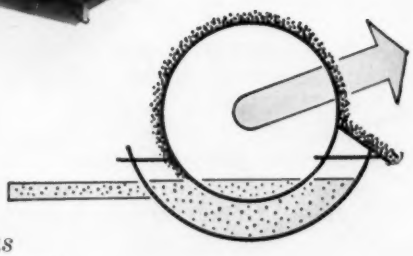
A long-term project at Dorr-Oliver, aimed at increasing fundamental knowledge, has brought to light many previously unknown principles affecting thickener operation.

Relatively simple laboratory tests permit accurate prediction of performance. These developments have resulted in a new understanding of the potentialities of the thickener as a tool for the processing industries.

If your flowsheet offers opportunities where the unit operation of sedimentation may be employed, maybe a fresh appraisal of the various types of Dorr Thickeners is in order.

## FILTRATION EXPANDS ITS SCOPE





*New ideas and equipment increase potential*

Pick any processed material and it's dollars to doughnuts that somewhere along the production line there's a filter.

Keeping on top of the many demands made on filtration equipment by modern processing often presents some tricky problems. Take corrosive applications, for instance. With rotary drum type filters, usual practice calls for stainless steel or rubber-covered construction. Capitalizing on advances in materials of construction, Dorr-Oliver engineers recently developed a filter with all essential components fabricated from tough, glass-reinforced plastics. The plastic construction not only resists corrosion, but it is also lighter and lower in cost than comparable standard machines.

This new filter has been successfully tested in handling acid leach solutions in a uranium mill and is now offered as a regular component of the Dorr-Oliver line.

This development is quoted as an example of the many contributions made by Dorr-Oliver to increase the scope and versatility of filtration equipment. Actually, it's just about impossible to think of any type of filter for any industry that hasn't been developed or improved by Dorr-Oliver engineers.

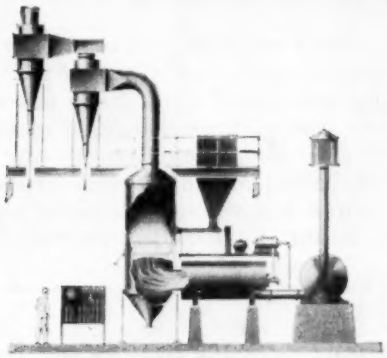
***Dorr-Oliver engineers are constantly at work in these four fields. For help in solving any problems you may be encountering***

***Dorr-Oliver offers a wide range of equipment, methods and complete systems for processing industries.***

***Operations include:*** **ROASTING • DRYING • CALCINATION •**

# A report on developments in equipment and methods of interest to the processing industries

## WHAT'S NEXT IN SOLIDS FLUIDIZATION?



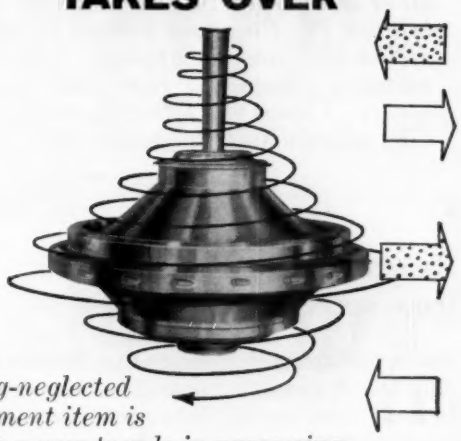
*A versatile drying, roasting and calcining technique offers opportunities in chemical processing*

Since Dorr-Oliver first introduced the fluidization technique for non-catalytic applications more than ten years ago, it has been widely applied in such operations as the roasting of sulphide ores, $SO_2$ production for acid manufacture, drying of fine coal and drying and sizing of limestone. Development is now extending into many fields of chemical processing.

The advantages of FluoSolids®, Dorr-Oliver's system for fluidized bed techniques, are its essential simplicity, its compactness, its low operating and maintenance costs, its ability to take wide feed variations and its inherent adaptability to precise temperature control with simple instrumentation. It has proved particularly effective in drying wet, sticky or otherwise difficult-to-handle materials. In some drying operations, the added benefit of classification by particle size is possible.

At D-O's research and development center, Westport, Connecticut, hundreds of test runs covering many possible new applications have been completed. Typical of these are the drying of heat sensitive polymers, drying of sodium chlorate crystals and potassium silicon fluorides, drying of chemical precipitates, roasting of furfural residues, and low temperature calcination of phosphates. Opportunities for still further development are far from exhausted.

## THE CENTRIFUGE TAKES OVER



*A long-neglected equipment item is starting new trends in processing*

Centrifuges have now become so versatile in operation and have advanced so much in size, power and capability that opportunities for profitable application are virtually unlimited. In many cases, they are replacing filters, settling tanks, screening and other separation and classification equipment, cutting days off processing time. Important, too, since the centrifuge substitutes horsepower for size, is the greatly reduced floor space requirements and the smaller amount of critical material needed when handling highly corrosive solutions.

Dorr-Oliver has taken a leading part in the development of these newer, more versatile and more powerful units. Features of Dorr-Oliver design are the overhead bearing and drive which remove some of the limitations of conventional units and the revolutionary return flow principle that permits concentrating, washing, clarifying, classifying and recovery of soluble values at pressures up to 150 psi. Probably the largest centrifuge now in operation is a Merco® unit built by Dorr-Oliver. Rotor speeds up to 3300 rpm and capacities up to 600 gpm are possible. Smaller size, specialized units, among them the Mercone® Screening Centrifuge, are finding application in the food and pharmaceutical industries.

To those interested in the possibilities of centrifugation, Dorr-Oliver offers a wealth of information. For investigation and evaluation, pilot plant models are offered on a sale or rental basis.

***in filtration, fluidization, sedimentation or centrifugation, write to Dorr-Oliver Incorporated, Stamford, Connecticut.***

**CLASSIFICATION • THICKENING • SCREENING • FILTRATION • CLARIFICATION**
**WASHING • AGITATION • CENTRIFUGATION • ION EXCHANGE • PUMPING**

Although only one firm—Valentine Paper Co.—makes pulp from bagasse in this country, worldwide interest in bagasse as a fiber source continues to mount. Parsons & Whittemore, New York, for example, is engineering four plants around the world: one in Egypt, one in Argentina and two in India. P&W's pulping process is built around the Pandia continuous digester.

---

***Explosion and fire in Dow's glycerine plant at Freeport, Tex., killed six and injured 14. Fire was caused by allyl dichloride and propylene chloride escaping from a ruptured vapor feeder. This is the latest in a series of CPI plant disasters (see p. 114).***

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## Reactors, not A-bombs, profit from secret U-235 process

Gas centrifuging of uranium hexafluoride to produce U-235, recently rumored to be a cheap way to make atom bombs, turns out to be much more practical for enriching uranium for use as reactor fuel. Now concern over recent centrifuge developments has been shifted from national security to individual profits as West Germany moved to have its patent office declare centrifuge technology a "state secret," after prompting from the U.S.

The background: natural uranium is largely U-238 containing about 0.6% of isotope U-235. For bomb use, U-235 concentration must be raised to 90%; fuel for nuclear power reactors needs only slight enrichment. The German system of gas centrifuging (*Chementator*, Feb. 22, p. 51), which takes advantage of a very small density difference between the hexafluorides of the two isotopes, is said to enrich the natural uranium to about 3% U-235 in a single stage, or to about 6% in multiple stages—still far too low for bombs but very satisfactory for reactors. Process uses 90% less power than AEC's gaseous diffusion route, which raised fears that every country could now afford to become a nuclear power.

German technologists apparently are leading in this potentially profitable business of making cheap reactor fuel. At least two different designs have been patented and ten centrifuges have been shipped from Germany to companies in this country and Brazil. Some U.S. companies that have already bought patent rights in the centrifuge were dismayed when Bonn, at the request of the U.S. State Dept., asked its patent office to declare the patents a state secret.

Other U.S. companies who were developing centrifuge processes of their own were equally resentful when the Atomic Energy Commission placed centrifuge separation work in the "secret" classification. All seem to feel that German companies will get a technical head start on commercial applications, consequently will cash in first on profits.

---

***American Potash will boost its boron production at Trona, Calif., by 35% in third quarter of 1961. Firm has developed a process that frees it of economic dependency on byproducts, allowing expansion of boron production as demand warrants without worrying about markets for coproducts.***

---

## (Another) process makes pig iron without benefit of blast furnace

Latest in the series of direct reduction processes was described at AIME's Metallurgical Society meeting in Philadelphia last month. It involves carbonization and prereduction of coal-ore-limestone pellets followed by final reduction in a submerged-arc furnace.

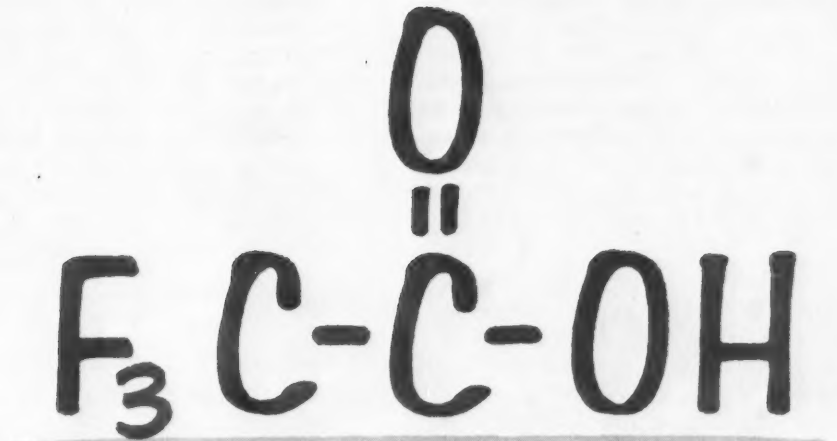
Developers of the process—McDowell Co., Cleveland, and McWane Cast Iron Pipe Co., Birmingham, Ala. (through joint work at McDowell's Dwight-Lloyd Research Laboratories)—estimate that a 550-ton/day plant would require a capital investment of about $8 million vs. about $17 million for a conventional blast furnace and $9-15 million for complete reduction by electric arc furnace.

Piloted in a 1,000-lb./hr. (pig iron) unit, the process is fed with hematite or magnetite ore concentrates (49-65% Fe), noncoking coal (30-36% volatile matter) and limestone—all crushed to −20 mesh. Pulverized materials are combined with water on a 6-ft. dia. "flying saucer" disk pelletizer, to form 15%-moisture balls about ⅜ in. in diameter.

The balls, layered 6 in. deep on a traveling grate, then pass through a narrow gas flame that ignites them. During the next 15 min. on the grate, as air is blown through the bed, the balls

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# TRIFLUOROACETIC ACID

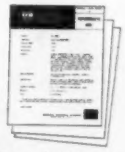
General Chemical now offers another functional fluoro-organic compound – *Trifluoroacetic Acid* – in developmental quantities. This non-oxidizing, strong acid shows unusual properties that suggest great utility in fluoro-organic synthesis and as a versatile catalyst for condensations, esterifications, polymerizations, Friedel-Crafts reactions and the like. If you are interested in any of these reactions, General Chemical's Trifluoroacetic Acid should be included in your investigations.

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are heated to about 1,900 F. About 50% of the iron oxide is reduced to Fe before the pellets feed into a submerged arc electric furnace where reduction is completed in another hour. Hot metal and slag are drawn off separately.

On paper, economics of the process look good, but so have those of several previous direct reduction schemes that have not been commercialized. These processes may have a tough fight for realization in the face of revitalized blast-furnace technology, say some industry observers.

---

***Chemetron Corp.'s sugar diffusion process* (Chementator, *Dec. 28, 1959, p. 22*) *will get its first commercial test in a 400-ton/day mill to be erected for a sugar company in Trinidad. Plant will be operating in time for the sugar harvest at the end of 1961.***

---

## Natural gas and fuel oil vie for role in blast-furnace revolution

The steel industry is gearing up for changes in blast furnace operation that will prove as dramatic and far-reaching as the changes wrought by the basic oxygen steel process and the revitalization of the open hearth furnace. These upcoming blast furnace improvements will have many ramifications: increased sale of oxygen to the steel industry, decreased coke consumption along with decreased output of coke-oven chemicals, decreased attractiveness of the many by-pass-the-blast-furnace schemes, and competition between oil and natural gas for use as blast-furnace fuel supplement.

Evidence of this last effect can be seen in Esso Research & Engineering's recent announcement that it is working with Dominion Foundries & Oil to perfect an oil-injection system for Dominion's new $10-million blast furnace at Hamilton, Ont. Object: to substitute cheap oil-derived Btu.'s for expensive coke Btu.'s in the ironmaking furnace.

Esso's decision to participate in developing steel technology has been prompted both by the potential market for fuel oil in blast furnaces and by dwindling markets in open hearth operations as more furnaces switch over to oxygen. Outcome of the fight between oil and gas in this new application will probably be decided mainly by local economics, with the advent of natural gas from Canada at as low as 28¢/1,000 cu. ft. guaranteeing that the competition will be keen.

Natural gas marketers are heartened by the news that Colorado Fuel & Iron has demonstrated that natural gas injected into blast furnaces can save 75 lb. coke for each 1,000 cu. ft. of gas. Savings are so attractive that CF&I is piping up all four of its blast furnaces at Pueblo, Colo., to use natural gas—injected at a rate of about 5% of the normal air blast. Boosters of natural gas also point out that oil, unlike gas, introduces undesirable sulfur into the molten pig iron.

---

## Chemical agglomeration allows use of synthetic rubber latex in foams

Naugatuck Chemical, division of U.S. Rubber, has revealed how it produces a high-solids SBR synthetic rubber latex that can compete with natural latex in production of foam rubber articles. The secret: agglomerate small rubber particles with treated polyvinyl methylether (PVM).

Although synthetic rubber has been crowding natural rubber in almost all applications, foaming processes have resisted synthetic's penetration because of the need for a high-solids (65%), free-flowing latex. While natural latex fills these requirements, standard synthetic latex becomes putty-like when concentrated to high solids content. And controlling polymerization to achieve the correct synthetic rubber particle size is prohibitively inefficient.

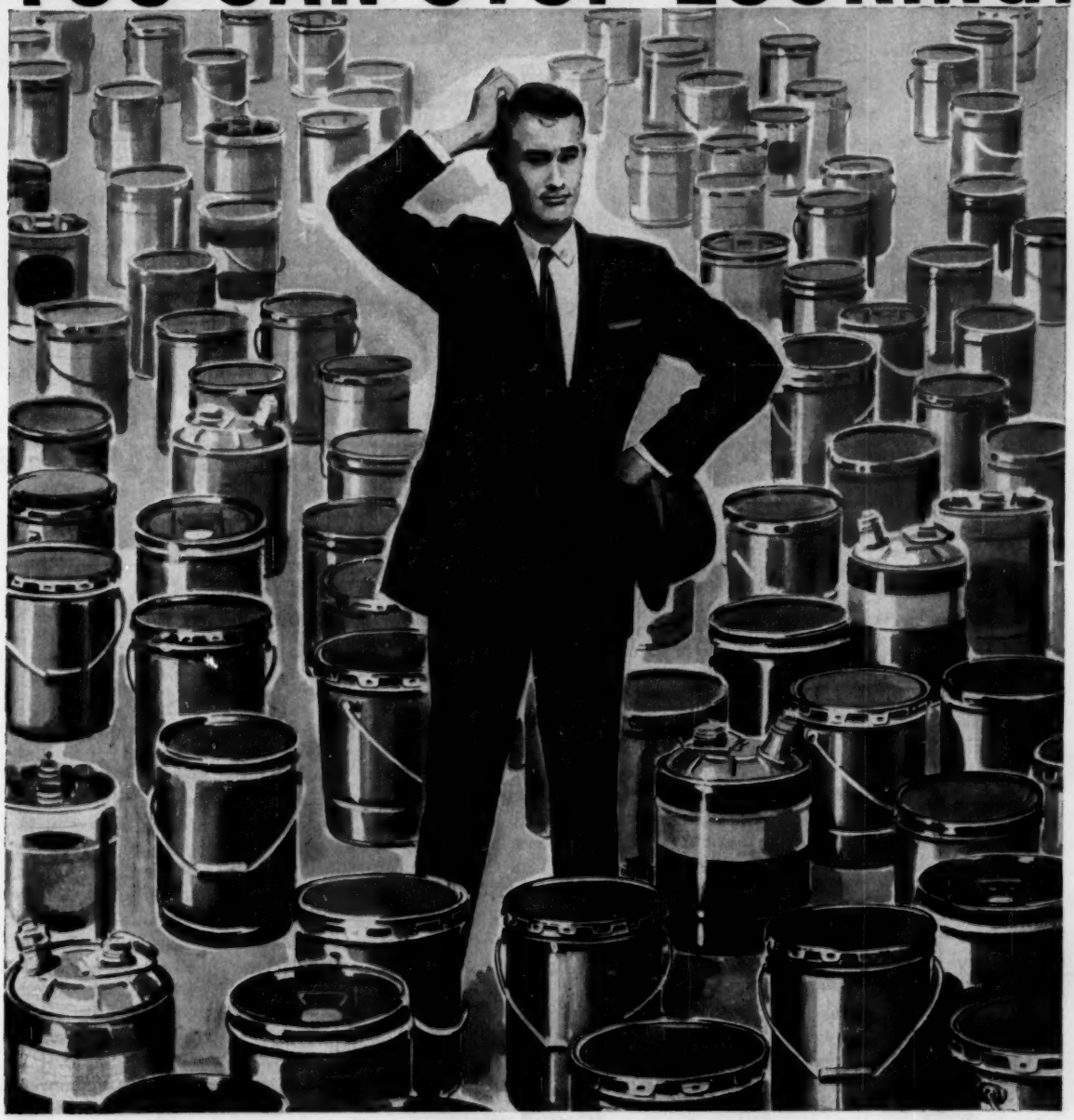
Naugatuck is using its discovery to produce a high-solids styrene-butadiene latex, polymerized conventionally at 41 F. with 80% conversion. After removal of unreacted monomer, the small-particle latex (average dia.: 600 Angstroms) is concurrently dehydrated and agglomerated. The concentrator-evaporator is half-filled with latex along with a dilute solution of PVM and an electrolyte. Unit operates at 105 F. under a 28-in. Hg vacuum.

After latex reaches a solids content of 65%, agglomeration stops; concentration continues until solids content reaches 70%. Final particle size is about 2,500 A. Price of this latex in tank car lots is 32¢/lb., which is competitive with natural latex.

The special treatment for the PVM agglomerator is a secret Naugatuck is keeping to itself. Its treated PVM is 50 times more effective than the untreated chemical originally used.

*For More Industry News . . . 110*

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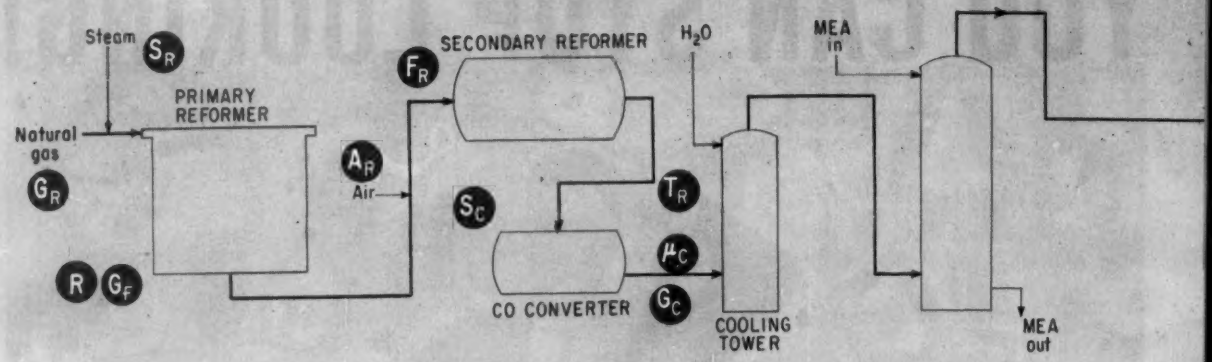
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**Computer supervises important control points***

# IN BIG COMPUTER TEST, PLANT RAISES

***At 500+ ton/day facility outside New Orleans, computer control gets its biggest CPI test yet, increasing the production of $NH_3$ in agricultural-chemical complex. Its unique features: adaptive control, attention to weather.***

When Monsanto Chemical Co. established its systems engineering section in March 1957, one of the jobs it assigned the group was investigation of computer control.

Several weeks ago—on the day Bill Mazeroski ended the World Series—Monsanto's Barton Plant personnel conducted outsiders through what is thought to be a successful milestone of the study: a battery-limits ammonia plant under complete, pathfinding computer control.

This plant, part of a complex at Luling, La., that includes nitric acid, nitrogen solutions and ammonium nitrate manufacture, was completed for Lion Oil Co. by Chemical Construction Co. in 1954. The following year, Monsanto purchased Lion and since then has added a small adipic acid plant and expanded $NH_3$ production.

▶**Why Computer Control?**—Monsanto decided that the computer would have to be justified as a production tool, not as a research project. The firm chose the Barton $NH_3$ plant for its initial computer-control test because it met three criteria:

- Product value had to be high enough so that improvement by computer would pay its cost.
- Plant process had to be well enough known so that outsiders wouldn't gain proprietary data.
- Instrumentation of plant had to be complete and modern so modification wouldn't obscure gains.

Monsanto has found that during its seasonal peak production, it can use and sell all the ammonia it makes at Luling. And price of product ($92/ton) makes the few percentage points of production improvement foreseen a good justification for the approximately quarter-million-dollar cost of installing computer control.

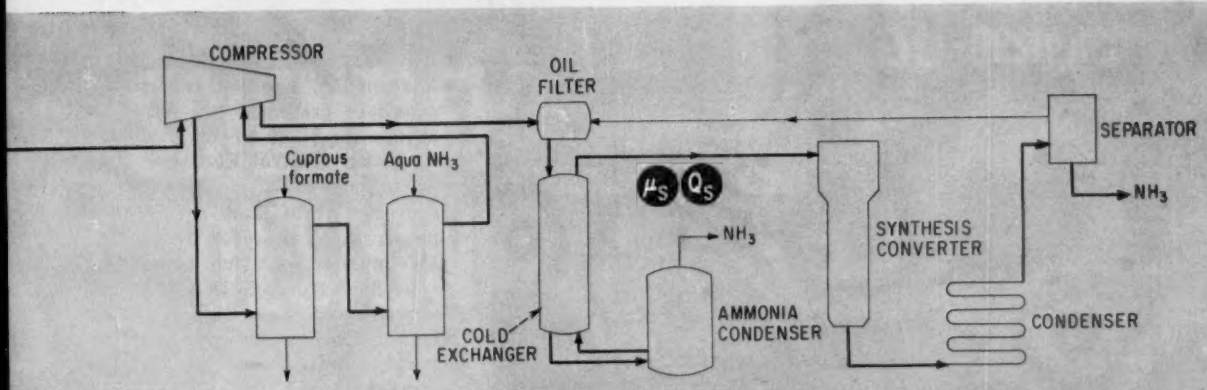
▶**Figuring the Payout**—Although it hasn't revealed the production base from which it starts payout calculation, Monsanto took over a nominal 300-ton/day facility when it bought Lion Oil, jacked production up to about 450 tons/day.

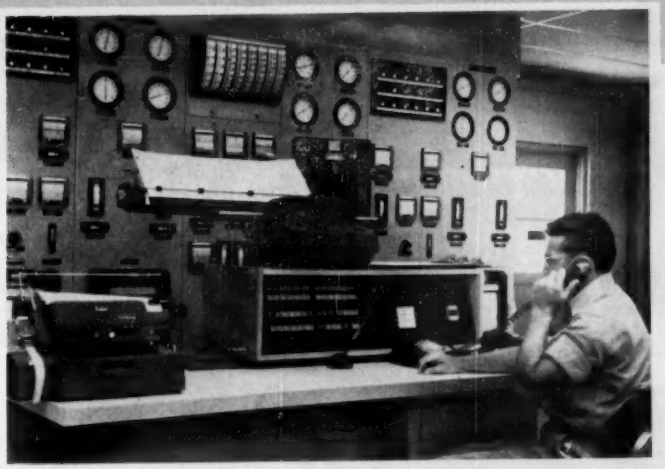
After adding a seventh compressor in expansion, decided upon after the computer study had been initiated, the plant opened up a production bottleneck that probably boosts $NH_3$ capacity to about 525 tons/day. And right now, an eighth compressor is being installed.

Total investment in the battery-limits plant is probably about $20 million. With 2-3% return before taxes on this investment, the computer project can pay out in one year. Such return requires a 3½-5% increase in the probable 525-

***Control points**

Reaction-gas flow to primary reformer, $G_R$. High-pressure steam flow to reformer, $S_R$. Fuel-gas flow to reformer furnace, $G_F$. Fuel-air ratio, reformer furnace, $R$. Air flow to secondary reformer, $A_R$. Flue-gas flow to secondary air blower, $F_R$. Low-pressure steam to CO converter, $S_C$. Desired synthesis-gas feed rate, $Q_S$. $H_2$:$N_2$ ratio at synthesis reactors, $\mu_S$. $H_2$:$N_2$ ratio at CO converters, $\mu_C$. Fuel-gas content at CO converters, $G_C$. Secondary reformer temperature, $T_R$.



Input-output typewriters sit at computer console in the control room.

## $NH_3$ OUTPUT

ton/day plant production peaks.

A word about accounting methods is pertinent: Monsanto's Research and Engineering Div., in which the systems engineering section works, doesn't charge operating divisions for services of its men and computing machines. The considerable groundwork laid in the R & E division wasn't charged to the project.

▶ **About the Process**—At Luling, Chemico's medium-pressure process, whose major steps are shown in the flowsheet, consists of two parallel trains of reforming, shift conversion and $CO_2$ absorption that feed synthesis gas to a common header. This gas is compressed for CO absorption after which it's further compressed to 350 atm. before entering fixed-bed synthesis converters (three parallel reactors at the Barton plant).

With about 25% conversion during a pass, rest of synthesis gas, separated from product ammonia, is recycled within the synthesis loop. (For more-complete descriptions, see *Chem. Eng.*, Aug. 1951, pp. 174-7; May 1954, pp. 140-2; May 18, 1959, pp. 72-3.)

▶ **Chasing the Variables**—When Monsanto engineers believed that the Barton ammonia plant might meet their three criteria for computer control, Thompson-Ramo-Woolridge Computers Co. was called in for a joint study.

Initiating the process analysis at the end of 1957, TRW presented a report in July 1958 that shows technical and economic feasibility of digital computer control of the Chemico process in general and of the Barton plant in particular. Members of Monsanto's R & E division helped complete the study.

Capital costs, as outlined in the report, included $98,000 for an 8000-word, magnetic-drum RW-300 computer; a fixed fee for TRW engineering services; and costs of addition and modification of plant pneumatic instrumentation. Upon re-estimation by Monsanto engineers, these last costs were more than doubled—a move vindicated by the time all the bills were in.

Presented to Monsanto management, the credits given production improvement provided an indicated payout that satisfied the firm's requirements. The project was given a go-ahead, assigned to the Inorganic Chemicals Div., which then included the Barton plant. (Since Sept. 1, the plant has been in the newly formed Agricultural Chemicals Div.)

▶ **What's in the Report**—There had to be strong backup to commit funds to this particular project. Lacking concrete experience, the backup took the form of a mathematical model of the plant.

The mathematical model (a quantitative statement of the problem by which the computer determines control action) is the most complex of three parts of the computer optimization program. Two other parts—the process objective (at Luling: to maximize production) and the system constraints—are important but required less effort to obtain.

The joint-study team of Monsanto and TRW engineers soon



View from reformers shows CO converters (foreground), then cooling scrubbers, control room, MEA units, and synthesis converters.

found that they couldn't develop the necessary *theoretical* relationships for the model. They chose instead to study plant operating data statistically to determine variable relationships.

By regression analysis of plant log-sheet entries, supplemented by correlations based on observation of some actual plant runs, the empirical relationships were obtained. Log sheets, in particular, reflected seasonal plant operation and the effects of ambient conditions on capacity.

► **Doing Something About Weather**—At Luling, the weather does strange things to processing. Sudden showers, for example, drop ambient temperature 20 deg. F. in moments and when they cease, temperature rises as suddenly.

From operating records, points of production vs. ambient temperature were plotted, and regression analysis on an IBM 704 provided a function from them. When shifted to pass through the maximum data points, the function showed maximum production that might be expected at a given temperature.

Comparison of maximum expected production with actual production that was obtained at a particular temperature provided a prediction of increased production possible from the existing equipment. To be safe, only two-thirds of the computed improvement was used in the profitability study.

This and other relationships that show dependence of certain process variables on other process variables and parameters, formed the basis for the model.

► **Content of the Model**—Describing the control variables, measurements and calculated factors listed earlier, control equations in the model were derived to meet the computers control objectives.

The joint-study team found that the engine-compressor system was a primary bottleneck in boosting production. Ambient conditions strongly affect efficiencies of units in this system, allowable compressor horsepower dropping off with ambient temperature increase.

But since gas flow to the synthesis converters can regulate total horsepower, the computer calculates allowable flow for horsepower available and then regulates it at that level. Allowed flow $Q_s$, dependent on number of on-line compressors, horsepower, temperature and pressure at compressor inlet and pressure of synthesis unit, is compared with desired-production gas flow rate by the computer; the lower of these values is chosen for plant control.

In applying any change in control level of $Q_s$, however, a limiting equation prevents too rapid a change for plant inertia.

► **Another Control Equation**—The whole purpose of the reformer-CO converter train is to prepare the proper $H_2$:$N_2$ ratio for the synthesis converter. Optimum ratio, theoretically 3:1, had to be determined experimentally, and this operating ratio is maintained by regulating $H_2$:$N_2$ ratio at exit of the CO converter.

Since $CO_2$ is removed from synthesis gas by the MEA absorber, flow at the synthesis converter is less than the total gas flow from the CO converter. To correct the ratio at the CO converter to a desired value after upset in the synthesis converters, the computer operates on an equation of the form

$$\mu_{c,\,new} = \mu_{c,\,old} + k_3 \{[3.1 + k_4\,(2.6 - \mu_s)] - \mu_c\}$$

► **Using the Adaptive Principle**—By techniques similar to those developed by G.E.P. Box, but simpler, the model is slowly and continuously modified to produce increasingly better optimization. Equations are provided that automatically adjust the $k$ coefficients if the model doesn't exactly represent the actual physical system.

This "adaptive-control" idea means that if the process analysts overlooked an effect on plant operation, the computer may be able gradually to find it and adjust its own program to compensate for it. Inclusion of this feature means that the Monsanto application is a combination of model-solving and evolutionary-operation approaches to computer control.

The model and resultant computer program can also, of course, be adjusted manually.

► **Putting in Hardware**—After assignment to the operating division, the project was supervised by an engineer who coordinated Monsanto's work with TRW.

Actual programming of the computer by TRW was started at the same time.

Since the computer "supervises" conventional control loops by adjusting their set points, modification of existing pneumatic equip-

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Dormagen, Germany

**ALLIED CHEMICAL CORPORATION**
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ment was necessary to provide local and computer modes of control. New instrumentation included Monsanto-modified chromatographs and input-output devices to transduce process pneumatic analog signals to computer electric pulse signals.

Although maintenance of the computer is handled by an on-the-spot TRW service engineer, maintenance requirements for other instruments have stepped up. Since measurement inaccuracies are reflected in less-than-optimum computer control, maintenance men exercise more care than ever.

▶**What Can Be Learned?**—The answer to that question depends on whom you ask. Process engineers and operators, at first skeptical, now think the computer will help.

The engineers see a chance to learn much more about a process and plant they thought they knew well before. Operators, initially unused to seeing the constantly shifting chart-pen lines under computer control, soon learned that the computer was probably helping them. Logging of calculated data during startup and off-control periods made this clear.

Finally, since 500 words of storage and about 40% of computing time are still available on the computer, studies will be made to see if this capability can be used for cost and engineering calculations.

A big question remains, though: How can the company actually separate improvement due to the computer from improvement due to the independently planned expansion? In examination of its other processes (some have already been proved economically unattractive for computer control), it will want the answer many times.—WCS

## EXPLOSIONS RIP CHEMICAL PLANTS

- *Eastman blast kills 15, demolishes entire unit.*
- *Part of Dow's polyolefin capacity goes up in smoke.*
- *Allied's spectacular fire seen 10 miles away.*

Three severe explosions in as many months have hit chemical plants around the country, leaving in their wake 15 dead, several severely injured and over $5 million in property damage.

Most recent blast, and by far the worst, completely wrecked Tennessee Eastman's aniline unit at its sprawling 400-acre chemical installation at Kingsport, Tenn. Of the 15 workmen who were killed, apparently none were directly connected with the aniline plant. They just happened, by tragic coincidence, to be in the vicinity when the explosion occurred.

The outdoor-type plant, operated remotely from a control room 500 ft. away, was protected by a deluge-sprinkler system. But this safety device was completely demolished along with the rest of the unit when the explosion occurred. The control room, however, was unaffected by the blast and it is hoped that examination of the recording instruments will eventually point to the exact cause of the disaster.

At the time this issue went to press, company officials said that it was still too early to speculate on what had triggered the explosion. A preliminary estimate of the damage was $4.5 million. Rebuilding plans: indefinite. Originally erected in 1958, the plant used a secret aniline-making flowsheet. When queried by *CE*'s Atlanta bureau, company spokesmen would not reveal either the materials or operations involved in the process.

Earlier, an explosion and fire ripped through Dow Chemical's Bay City, Mich., complex, seriously injuring six workers and damaging the high-density polyethylene and polypropylene plant. A blaze in the polymer plant apparently flashed back into a reactor. Damage is pegged at about $100,000; a portion of the production capacity has been knocked out for about a month.

A month earlier, a blast at Allied Chemical's Buffalo, N. Y. plant set off a spectacular fire that was visable ten miles away. Two operators were injured when a three-story brick building, housing a part-time dianisidine and dichlorobenzene process, was destroyed. National Aniline spokesmen estimate that the explosion caused well over $1 million damage, although no other units were affected. They say that a new plant to be erected at the same site will contain "many improvements" over the unit it replaces.

These events have caused chemical processors to scrutinize safety precautions in hazardous processes even more closely, and make the development of explosion-prevention devices (see p. 140) even more urgent.—FCP

## Nonmetallic Conquers Metals in Rocket Race

Rocket engineers, who recently debated the merits of metal and plastics for rocket casings (*Chem. Eng.*, Oct. 3, p. 46), have again put their stamp of approval on a nonmetallic. They have picked a new material, recrystallized graphite, for an improved rocket nozzle insert. Having two to three times the high-temperature strength of conventional graphites, National Carbon's high-density supergraphite can be used at temperatures up to 5,500 F.

Test results on rocket motors fitted with recrystallized graphite nozzle inserts so impressed the Air Force that details of new graphite production process have been

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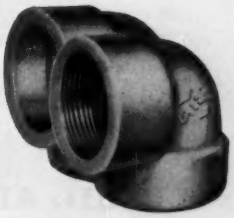
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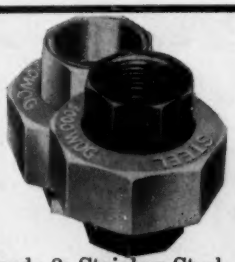
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classified and all production is earmarked for the military. The nozzle inserts are said to stand up to erosive exhaust gases better than, or at least as good as, tungsten.

National Carbon does reveal one interesting point, which may have implications for the chemical industry once security wraps are removed. There is no technological limit to the size of machinable supergraphite structures.

## LIQUID ALUM GOES CONTINUOUS

*Chemico cashes in on materials-of-construction experience, proves process in 2,000-lb./day pilot plant.*

Technological cross-pollination has produced the first commercially feasible process for production of liquid and solid alum using continuous pressure digestion of ore, followed by filtration.

Engineers of Chemical Construction Co., New York, used experience gained in the recovery of metals from low-grade ore as a basis for overcoming the corrosive and erosive conditions inherent in the acid digestion step of the process.

Based on data obtained from its 1-ton/day liquid-alum pilot plant, Chemico predicts that commercial plants from 5 to 120 ton/day alum (8.3% $Al_2O_3$) can recover up to 10% more $Al_2O_3$ from bauxite than do existing batch plants, and do it at lower cost.

▶ **Why It's Better**—Inserting a continuous pressure digester into the process scheme in place of the conventional atmospheric batch unit provides definite process advantages:

- Pressure digestion can tolerate coarse ore, so fine grinding is eliminated.
- Pressure digestion recovers more of the ore's $Al_2O_3$ content.
- Processing time from feed to product is reduced from about three full days to approximately three hours.
- Space requirements are reduced by about 30%.

The net result of the continuous pressure-digestion step, according to Chemico, is a 10% saving in capital investment (about $6,700/daily ton) and 15% reduction in operating costs. Smaller plants would probably supply alum for water treatment, while the 60-ton/day (and up) sizes are slated for the papermaking industry.

Chemico's construction know-how made the digester possible. The unit's carbon steel shell is protected with a lining of acid-resistant brick. But the real trick is in sealing the agitator shafts against the highly corrosive mixture at the pressure and temperatures used. Mechanical seals, comprising stainless and alloy steels and ceramics, do the job, but no details of seal construction were revealed.

▶ **Through the Process**—Bauxite containing about 55% $Al_2O_3$ is crushed and slurried with either recycle or makeup water. Slurry then feeds continuously into the agitated reaction autoclave (digester) along with steam, 98% sulfuric acid and water. The ore is digested at 350 F. and 100 psi. for about two hours (compared with 220 F., atmospheric pressure, and about three days' residence time).

When digestion is complete, the product is continuously flashed to recover low-pressure steam, then filtered on a precoated vacuum drum filter to remove solid particles. Weak filtrate is recycled to the ore slurrying tank and strong filtrate is sent as 8.3% alum to the final product storage tank.

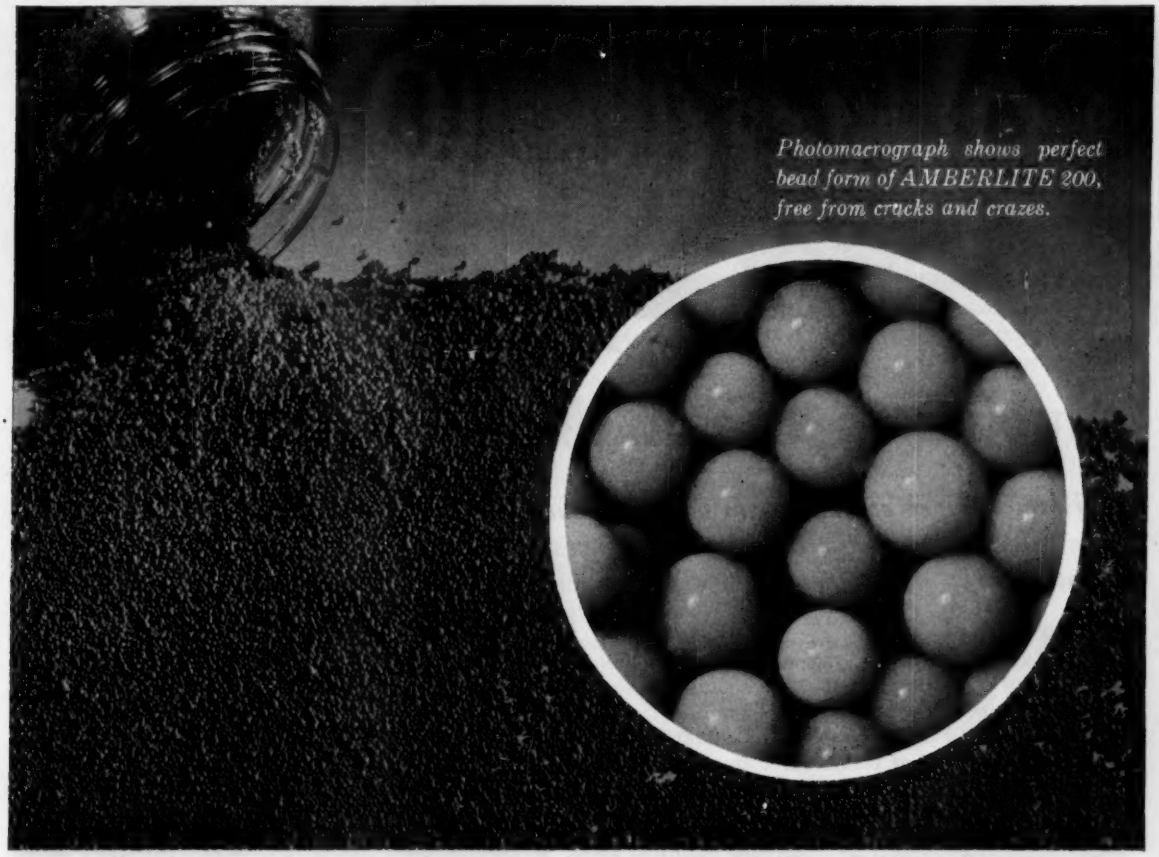
Principal space-saver in the new plant is the digester. In a 60-ton/day batch plant, three digesters covering 750 sq. ft. are needed. Chemico's continuous unit fits in about 80 sq. ft.

Another gain over the conventional process is the elimination of fine grinding. New process uses relatively coarse bauxite (minus 8 mesh), also can extract alum from lower-grade ore. Elimination of grinding and continuous operation also reduces manpower by one man/shift over conventional plants.—FCP

**Continuous operation ups alum recovery, cuts labor**

| Materials & Utilities* | Requirements/Ton 8.3% Liquid Alum | |
|---|---|---|
| | Continuous Process | Typical Batch Operation |
| Bauxite, 55 wt. % $Al_2O_3$, lb | 332 | 365 |
| Sulfuric acid (98%), lb | 482 | 482 |
| Filter aid, lb | 37 | 37 |
| Water, 85 F. | | |
| Process, lb | 169 | 169 |
| Cooling, lb | 193 | 155 |
| Steam, lb | 247 | 500 |
| Electricity, kwh | 30 | 25 |
| $Al_2O_3$ recovery, % | 90 | 82 |
| Manpower (man hr./day)* | | |
| Operations | 38 | 48 |
| Maintenance | 8 | 8 |
| Supervision | 10 | 10 |
| Total | 56 | 66 |

* Based on 60-ton/day capacity.



*Photomacrograph shows perfect bead form of AMBERLITE 200, free from cracks and crazes.*

# AMBERLITE 200

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AMBERLITE 200 represents an entirely new concept in polymer chemistry. A high capacity, strongly acidic cation exchange resin, AMBERLITE 200 has physical and chemical stability unmatched by any available cation exchange resin.

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In addition to water treatment in either hydrogen or sodium cycle operation AMBERLITE 200 has unusual value in the treatment of highly concentrated solutions such as sucrose and glucose, where resin dehydration causes rapid failure of conventional exchangers. Resistance to oxidation makes AMBERLITE 200 useful in treatment of highly aggressive solutions such as chromic acid or where high operating temperatures are involved.

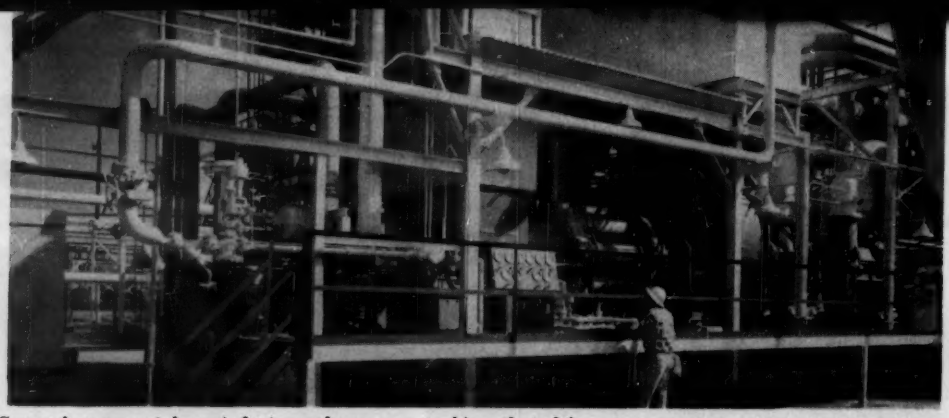
Write for full information and samples on this radically new AMBERLITE resin.

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Sunray's compact layout features large gas turbine that drives two compressors, generates steam.

# SNUG DESIGN RESHAPES WAX-PLANT IMAGE

***Trimmer, more compact than other solvent dewaxing plants, new unit boasts engineering features that make it an efficient, flexible performer.***

Like a variation on a theme, DX Sunray Oil Co.'s new $7-million solvent dewaxing plant at Tulsa, Okla., brings a fresh approach to the design of plants utilizing the standard Texaco methyl ethyl ketone (MEK) process.

In essence, this design variation consolidates and integrates equipment into an unusually compact layout that provides operating simplicity and flexibility at minimum cost.

To translate the layout from design to a 50,000-ton/yr. wax plant on a 230- × 310-ft. site, engineer-constructor Foster Wheeler Corp., New York, worked without any plan or piping drawings. A model of the plant was divided into eight subassemblies that were then set up at the respective site areas under plastic shields.

Workmen used these models and isometric drawings in building plant, marking the first time that Foster Wheeler has used this technique in the U. S. In its completed form, the plant incorporates:

- A gas turbine that is connected to two prime compressor loads while it generates byproduct steam with its hot waste gas.
- Towers and drums built as multiple units with internal heads; exchangers, on dissimilar services, stacked vertically—all to conserve site plot area.
- Deep-well filtrate pumps to obtain suction head needed to pump against vacuum in filter system. Ordinarily, filters are elevated 2 stories above grade to provide this head.
- Filter control valves located along the central walkway between two rows of filters, thereby simplifying operation.
- Electronic controls that quicken response for more precise regulation of the temperature-sensitive process.
- Automatic lubrication of wax chillers, controlled from central panel.
- Foamed glass insulation, instead of cork, to prevent heat gain by equipment operating at subatmospheric temperatures.

▶ **More About Turbine**—Sunray's combination of a gas-turbine prime mover with two major loads, connected in tandem, is said to be the first such arrangement in the process industries. It came about because installation of new steam-generating capacity to power steam turbine drives was not considered to be desirable at the present time.

By connecting the 2,000-ton centrifugal refrigeration compressor in tandem with the 19,000-cfm. centrifugal vacuum pump, Foster Wheeler obtained a combined load sufficiently large to utilize the power output from a 7,500-hp. gas turbine. The entire direct-connected rotating assembly of compressor and turbine wheels operates in the speed range of 6,500-6,900 rpm.

Hot exhaust from the turbine flows through a waste-heat boiler designed to generate 32,000 lb./hr. of 170-psig. steam, satisfying most superheated steam requirements of the wax plant.

The propane refrigeration compressor operates with main suction plus two sideloads that feed into intermediate stages in order to sustain three different levels of refrigeration economically. The vacuum compressor circulates inert gas to blanket the entire system. It also provides the driving force for filtration by pulling a 22-25-in. Hg vacuum on the rotary filters.

▶ **Inside Filter House** — Some of the 12 giant 700-sq.-ft. rotary vacuum filters have piping connections that allow them to operate on more than one of three filtrations used in the dewaxing-deoiling process. Such flexibility is needed, as the plant shifts from one feedstock to another.

Area overhead in the filter building is free of piping to assure complete working freedom for lifting either hoods or drums. Wash piping on the hoods can be disconnected easily at union fittings; hood lights get their electrical supply through plug-receptacle connections that disconnect easily.

▶ **Even Greasing Is Automatic** — To lubricate double-pipe chillers and exchangers most effectively, DX. Sunray relies on an automatic,

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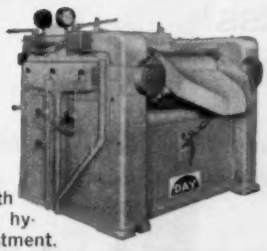
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Are the peak of design for all change-can mixing of liquids, pastes, granulations. Single and twin motion models.

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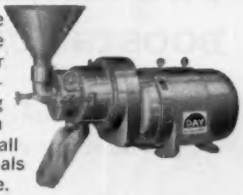
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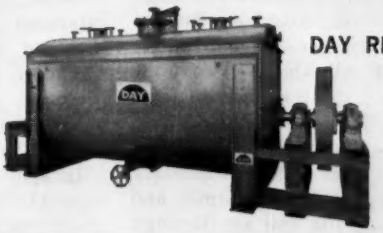


**DAY HY-R-SPEED MILLS**

They are the choice of the industry for grinding, homogenizing and blending, in one operation, all types of materials flowing or paste.

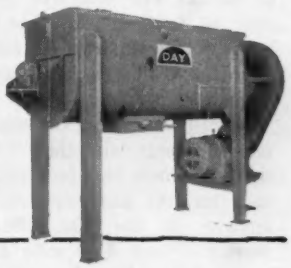


## for Blending



**DAY RIBBON BLENDERS**

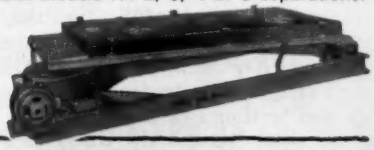
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seven - circuit system controlled from a central panel. First of its type in the process industries, this setup delivers lubricant to 1,064 points on the chillers.

Intervals between lubrication are set into a clock. Any failure in lubrication sequence is signalled immediately to the operator. On resumption of operation, the system automatically starts at the point where the sequence was interrupted.

▶**How Plant Helps Refinery** — Basic function of this plant is to remove wax from oil that is manufactured into lubricating oil, and refine the wax for market. Using any of four different fractions from the crude unit or a stream from the propane deasphalting unit, the wax plant can produce eight fully refined base wax stocks ranging from light paraffin wax to a high-melting-point microcrystalline wax.

Blending facilities, now going in, will allow production of wax and wax-polyethylene blends to satisfy most end-use requirement.—CSC

# TWO-STAGE PROCESS BOOSTS ACETYLENE YIELDS

***Redesign makes a.c. electric-arc process a contender in producing economical acetylene from natural gas.***

Skepticism about the practicality of electric-arc acetylene processes may be tempered in this country because of reports of successful operations in Czechoslovakia and Rumania.

Hard-pressed by increasing demand for acetylene, these European countries have been looking at their vast natural gas reserves for an answer. In the past, considerable work has been done with d. c. arc-furnaces for cracking natural gas (*Chem Eng.*, March 7, p. 62).

Power losses and high investment costs in elaborate equipment and instrumentation have now been drastically cut with a new two-stage a. c. process that combines some old features with novel ideas.

▶**What It's All About**—To stabilize the arc current, engineers at the Institute for Petroleum Research, Brno, Czechoslovakia, hook a reactance in series with the secondary circuit of a feed transformer and artificially ignite the arc through high-voltage oscillation impulses of high frequency.

The furnace electrodes quickly build up a voltage that approaches the effective no-load voltage for ignition and combustion of the gaseous hydrocarbons. Kept at an optimum distance of 1 mm., electrodes consist of an iron ignition ring and a copper lining.

These electrical circuit innovations pared 66% off power costs.

▶**Naphtha Quenching**—In the two-stage a. c. arc process, somewhat similar to the Huels d. c. process, acetylene formation from methane takes place at approximately 2,700 F. However, in order to keep a high acetylene yield and prevent side reaction, the product gas must be cooled from 2,700 F. to 400 F. within fractions of a second.

Cooling in the d. c. process is accomplished by a water spray. This wastes enormous amounts of potentially recoverable energy because the bulk of the cooling water is allowed, at the most, a 100 F. temperature increase..

Energy losses cannot be avoided with customary heat exchangers because of the rapid cooling requirements and the presence of liberated carbon and tar substances in the product gas.

Choice of naphtha as a cooling medium overcomes these problems. Between 1,100 and 1,700 F., naphtha cracks into methane, ethylene and acetylene while rapid cooling of the product gas occurs.

▶**Water Follows Naphtha**—Next, a water spray lowers the temperature from 1,100 to below 400 F. Unsaturated hydrocarbons and unreacted naphtha can then be recycled.

Introduction of this two-stage process gives more product gas and increases the concentration of ethylene, acetylene and other unsaturated hydrocarbons without input of additional energy. Consumption of energy per lb. of acetylene drops by 18-20%, and naphtha cooling recovers 10% of energy formerly wasted.

In addition, it makes no difference whether the energy is exclusively supplied by the arc or by partial preheating with a cheaper source of energy.

Where there is an electric-arc apparatus with existing separation facilities, the two-stage process is very simple because it requires only additional hydrocarbon sprays, pumps and a cooling tank.—EG

**Comparison of acetylene costs**

| Production Method | |
|---|---|
| **Cracking** | |
| In a.c. arc (Brnb process) | 100.0 |
| In d.c. arc (Huels process) | 140.0 |
| Ruhr-Chemie | 162.0 |
| Wulff process | 155.0 |
| **Carbide method** | |
| Electric furnace | 174.0 |
| Shaft furnace | 173.4 |
| **Partial oxidation** | |
| With methanization | 152.0 |
| Without methanization | 133.5 |

## See You in Kansas City

You have until Nov. 21 to save 10% on the registration fee for the Conference on The New Chemical Engineering, to be held in Kansas City, Nov. 29 and 30, (see *Chem. Eng.*, Oct. 31, p. 56). Write to B. C. Shaw, Midwest Research Institute, 425 Volker Blvd., Kansas City 10, Mo., for registration and hotel information.



# Do you need this to open the doors to your plant?

**IF THE DOORS TO YOUR PLANT ARE HARD TO OPEN . . . IF THEY SLAM SHUT LIKE STEEL TRAPS . . . YOU NEED MAKE-UP AIR.**

Slamming doors are just one symptom of a serious problem that can raise havoc with your plant and process efficiency and increase worker absenteeism. Here's why. Exhaust fans take out air along with the dust and fumes, creating a vacuum. Nature abhors a vacuum, so your plant attempts to make up the exhausted air any way it can . . . through doors, around windows and through cracks in the walls. It never quite succeeds so a partial vacuum remains. What does all this mean to you? Combustion processes are starved for air. Your exhaust fans don't work efficiently. Workers are too cold near drafty outside walls and too hot in the center of the plant. These things mean costly, inefficient operation and high absenteeism. Want a free evaluation of your plant's present ventilation system? Call in Westinghouse application engineers, experts on the subject . . . or write for our booklet on **balanced** ventilation. Dept. KDO4, Sturtevant Division, Hyde Park 36, Mass. You can be sure . . . if it's Westinghouse.

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## CPI News Briefs

- Processes
- Plants
- Offices
- Companies
- International

### Processes

**Hydrogenation of heavy oils** to light distillate products takes place in an ebullating catalytic reactor developed by Hydrocarbon Research, New York. Called the H-Oil process, hydrogen and oil flow upward into the two-stage reactor, agitating the catalyst and promoting intimate contact between it and the reacting fluids. Catalyst periodically discharges from the bottom of reactor. Catalyst life averages more than 10 bbl./lb., eliminating need for regeneration. Recycle of some product oil creates a heat sink that absorbs the large amounts of heat generated by the reaction. Typical reaction conditions for treating heavy residuum stocks are about 3,000 psig. and 800-850 F.; hydrogen consumption is about 1,000 scf./bbl.

**Utilization of geothermal steam** has been achieved by Pacific Gas & Electric's new 12,500-kw. generating unit in California's Sonoma County. Station's turbine-generators are turned by steam from wells drilled into volcanic formations that exist near the earth's surface in the area. It's the first such installation in this country, although geothermal steam has been used for years in Italy.

**Two secondary oil recovery schemes,** one commercial and one in the laboratory, are making news:

• Humble Oil & Refining will "dry clean" the Sub-Clarksville, Tex., oil reservoir by injecting propane-rich gas along with the usual waterflood. Over 2 million bbl. of propane will be purchased for this project. It's estimated that the program will recover 5 million bbl. of oil, about twice as much as could be garnered by waterflooding alone.

• Using steam instead of water may yield as much as 100% more oil than does waterflooding, reports Jersey Products Research, Tulsa, Okla. Lab findings show that steam expands the oil, decreases viscosity and provides some distilling effect. Because of this *in situ* fractionation, light-oil recovery is greater than with hot-water flooding.

### Plants

**Monsanto Chemical Co.** will build a 50-75-million-lb./yr. plant near Texas City, Tex., to produce phenol by oxidation of cumene. Scheduled to go on stream in the spring of 1962, the new unit will be the firm's third phenol facility; the other two employ a sulfonation process. The cumene route will be used in the new plant because Monsanto can make effective use of all of the route's byproduct acetone.

**Tennessee Eastman Co.,** Kingsport, Tenn., continues with its multimillion-dollar program to erect facilities for making the firm's new polyester fiber, Kodel. Construction of the main Kodel plant is in its final stages; due to be completed this quarter, the unit will have a capacity of about 20 million lb./yr.

The firm is also finishing construction plans for a terephthalic acid plant and a dimethyl terephthalate plant, which are being designed large enough to meet Kodel requirements for the two chemicals. Tennessee Eastman will also use some of the dimethyl terephthalate output in producing polyester resin film base. The two plants are scheduled for completion in the second half of next year.

**Rohm & Haas Co.** has begun erecting facilities to make acrylic products at the Louisville, Ky., site that the firm purchased earlier this year from the government (*Chem. Eng.*, June 27, 1960, p. 152). The construction will cost about $12 million, will probably be completed next summer. Plant products will include methyl methacrylate monomer, acrylic molding powder and byproduct ammonium sulfate.

**Sunray Mid-Continent Oil Co.'s** subsidiary, DX Sunray Oil Co., will start constructing a 1,000-bbl./day Hydeal hydrodealkylation unit at its Tulsa, Okla., refinery in January.. It will cost over $1 million, will produce benzene by treating a toluene stream from a nearby Udex aromatics extraction unit. The Udex facility is scheduled for completion this fall; its product slate will also include about 600 bbl./day benzene for a combined total of 1,600 bbl.

Another Sunray subsidiary—Suntide Refining Co.—is also installing a Hydeal plant, at its refinery in Corpus Christi, Tex.

**Stauffer Chemical Co.'s** Consolidated Chemical Industries Div. is building a plant to produce liquid sulfur dioxide at Baton Rouge, La. The 10,000-ton/yr. unit is due to go on stream late this year; it will be Stauffer's first sulfur dioxide facility.

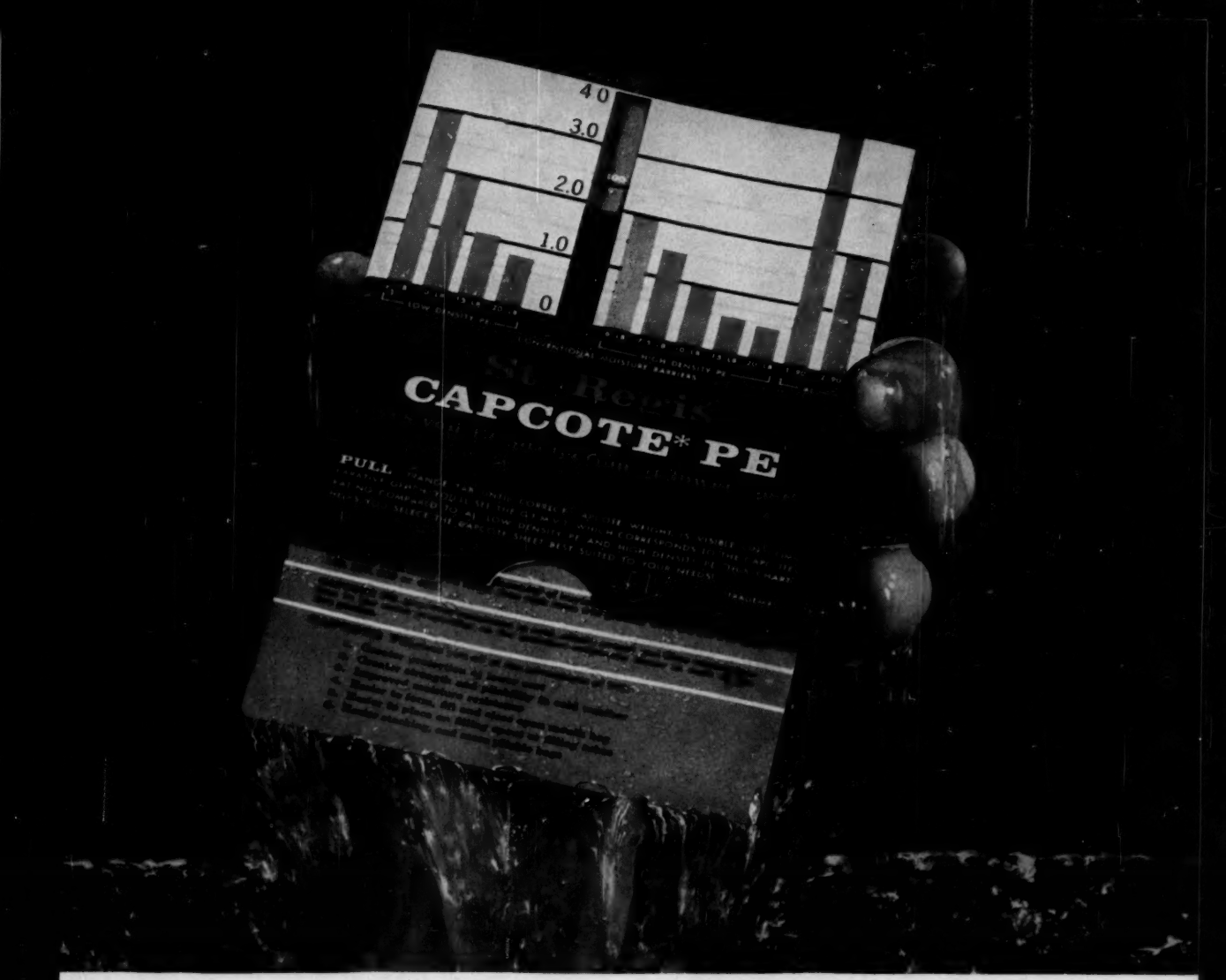
**Oklahoma Cement Co.** recently dedicated its new $8-million cement plant near Pryor, Okla. The installation has a capacity of over 1 million bbl./yr., with facilities for making shipments to customers by truck or rail.

**American Cyanamid Co.** is building a plant at Vancouver, Wash., that will make wet-strength resins for paper manufacture. Cost of the new unit is reported to be about $1 million. Construction, already underway, is by The Austin Co., Cleveland.

**Allied Chemical Corp.'s** Solvay Process Div. is undertaking an expansion program that will approximately double the facilities of its Syracuse, N. Y., research and technical service laboratory. The expanded facilities will be occupied late next year, according to present plans. Among the laboratory areas being enlarged are those for studies in corrosion, pulp and paper, plastics, chromium chemicals and chlorinated organic compounds.

**U. S. Rubber Co.'s** Naugatuck Chemical Div. will soon start building its forthcoming $2-million pilot plant at Baton Rouge, La., which

*CPI Briefs continued on page 258*




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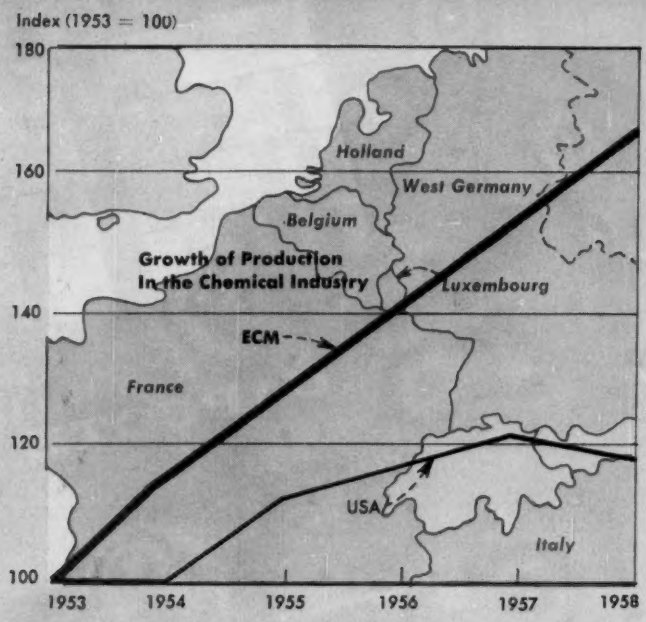
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# ECM BAIT...

# ...LANDS U.S. CHEMICAL CASH

***The European Common Market (ECM) offers: new opportunities for volume production in a fast-growing industry to serve 170 million people with fast-rising living standards.***

U. S. Expenditures in the European Common Market

| Industry | Actual 1959 | Planned 1960 | Planned 1961 |
|---|---|---|---|
| Chemicals | 15.3 | 54.2 | 91.4 |
| Rubber | 2.2 | 6.2 | 19.1 |
| Stone, clay & glass | 1.4 | 4.1 | 0 |
| Food & beverages | 1.3 | 4.3 | 2.2 |
| Petroleum | 137.2 | 152.2 | 174.1 |

Chemical makers, along with most other segments of U. S. industry, are moving into a new era, a period when foreign competition, already strong in some lines, will intensify. But it will also be a period of burgeoning opportunity.

Evidence is mounting that the chemical industry believes its future is likely to be ruled by the strength of its offense—continued new-product development and the buildup of production abroad—rather than by a defense of high tariffs.

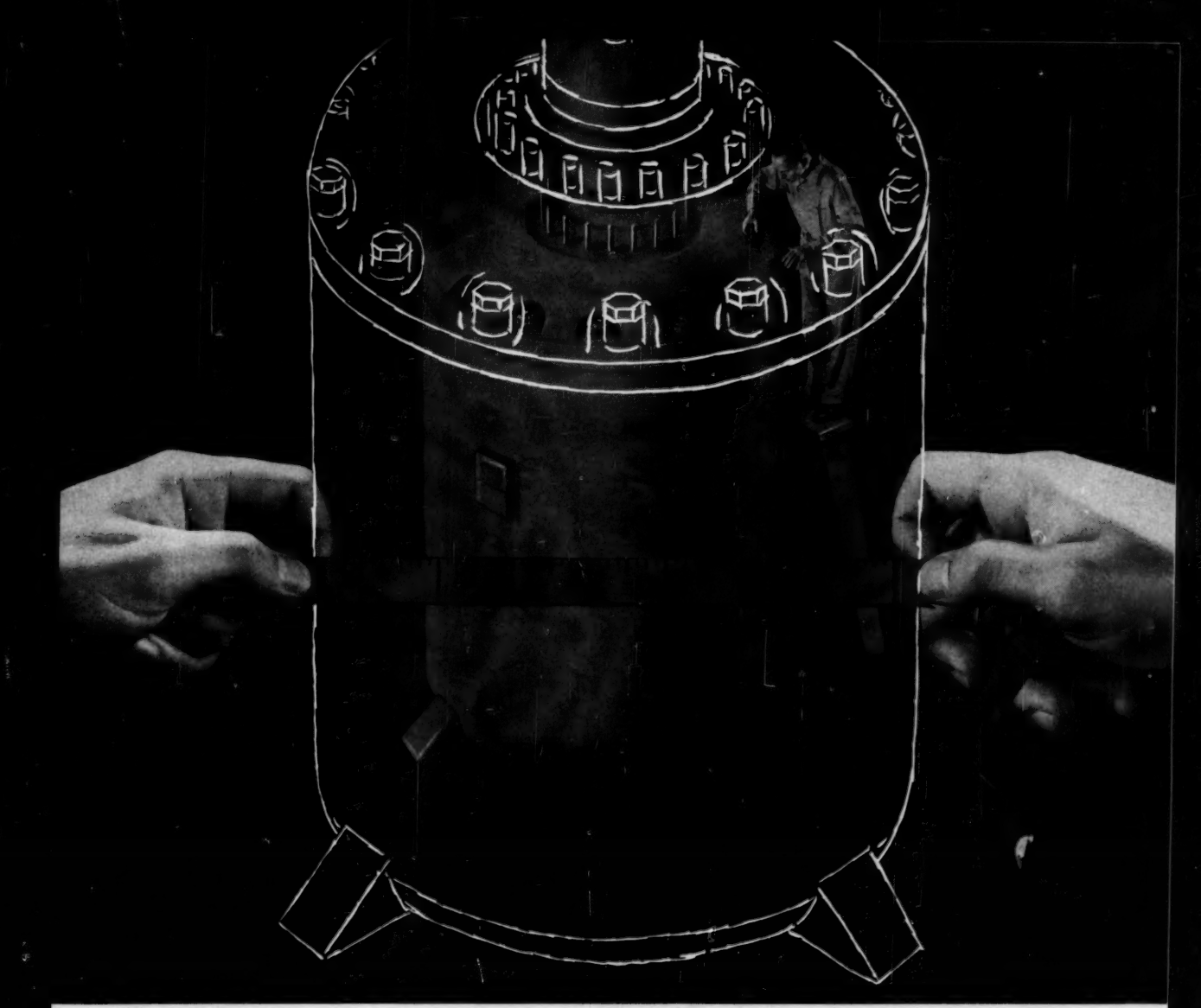
And the most striking pattern in overseas investment by U. S. manufacturers was revealed clearly by the second annual Survey of Foreign Operations,* conducted by McGraw-Hill's Dept. of Economics: the big swing to the European Common Market, with chemical companies in the vanguard (see chart above). With only 8% of 1959 expenditures tagged for the Common Market, these companies expect to boost the figure to 22% this year, 32% in 1961. Out of $175 million worldwide, the industry is investing $54.2 million in the Common Market this year.

The ECM is now in its third year of existence, second of active operation. Progress during this brief period has been rapid. Machinery to govern the bloc has been set up, the detailed operation has been well organized. In July, both the first and second steps in the series of tariff cuts and quota liberalizations were completed, thus freeing the flow of trade among the member countries—Belgium, France, Germany, Italy, Luxemburg and The Netherlands.

This new market is comparable to the one in the United States, so far as population is concerned, and it is rapidly catching up on purchasing power. For example, a company based in Belgium has a more concentrated market in many respects than a similar company located here. Within one hour's flight, only 120 miles from Brussels,

**Tons**
All tonnage figures in this article are metric; to convert to U. S. tons, multiply by 1.1.

* Much of the information contained in this article came from: (1) the second annual Survey of Foreign Operations, conducted by McGraw-Hill's Dept. of Economics; (2) "A Report on the Arden House Conference on the European Common Market and the American Chemical Industry," sponsored by Arthur D. Little, Inc.; and (3) papers presented at the European Chemical Industry meeting of the Chemical Market Research Assn., Sept. 1960.



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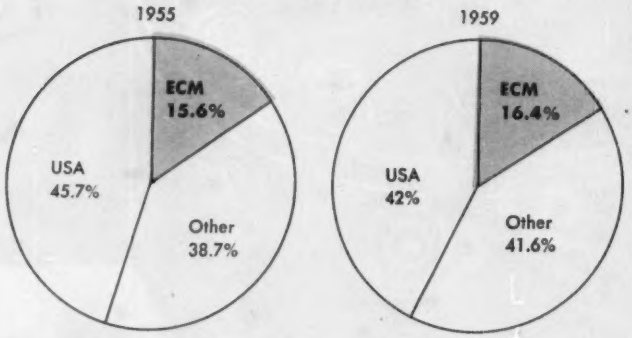
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Celanese CHEMICALS

**ECM's share of world chemical production is on the increase**




there are 170 million people—almost the population of the U. S. These people have a combined income equivalent to $125 billion/yr. In other words, the ECM is fast becoming one of the most convenient mass markets in the world.

▶**U. S. Needs ECM**—New market opportunities are the most important factor spurring foreign investment by the companies queried during the McGraw-Hill survey. Of the chemical firms surveyed, 43% cited new markets—rather than higher profits, availability of raw materials, lower labor costs, or competition—as the primary factor determining their decision.

The ECM's transitional period (during which duties on trade within the area will gradually be eliminated, while duties on imports from outside countries will be adjusted until the level of the Common Market tariff has been reached) is to end by 1970. The U. S. chemical industry appears to be in widespread agreement that it would be a mistake to wait for the outcome lest the attractive opportunities be seized by others.

Monsanto has doubled its foreign investment in the past five years; about 75% of these assets are located in Great Britain and Europe. Within the past year, Dow has announced plans to establish or expand facilities, mostly for plastics and resin production, in Italy, Germany and Holland. Since 1957, Du Pont has established three manufacturing enterprises and a sales company in Europe, has plans for further activity.

Union Carbide has a new petrochemical plant in Italy and is building a polyethylene plant jointly with a Belgian company near Antwerp. Reichhold has a new plant for resins, formaldehyde and pentaerythritol from natural gas near Bordeaux, France. Olin Mathieson has acquired stock interest in chemical and pharmaceutical companies in Italy, Belgium, France and West Germany. By the end of this year, American Cyanamid will have five manufacturing units in the Common Market area.

▶**Rewards of Scale**—Next to the ready availability of most resources, the great growth of industrial America has been based on the availability of a large and prosperous market area: all of the continental United States. With no trade restrictions among the States to worry about, opportunities for a U. S. manufacturer to expand have been almost limitless. The same advantages have not been available to the European entrepreneur, but the Common Market is correcting this.

▶**In Manufacture & Sales**—The promise of mass markets that can be served on the spot is a particularly strong incentive for the chemical industry, which must continuously create new products, depending on high-volume production in many lines. A significant characteristic of the chemical industry, both here and in Europe, is that it requires large capital resources for research, development and expansion. Furthermore, chemical processes, as a rule, become profitable only when the volume of production exceeds a fairly high level, and this level seems to be creeping upward.

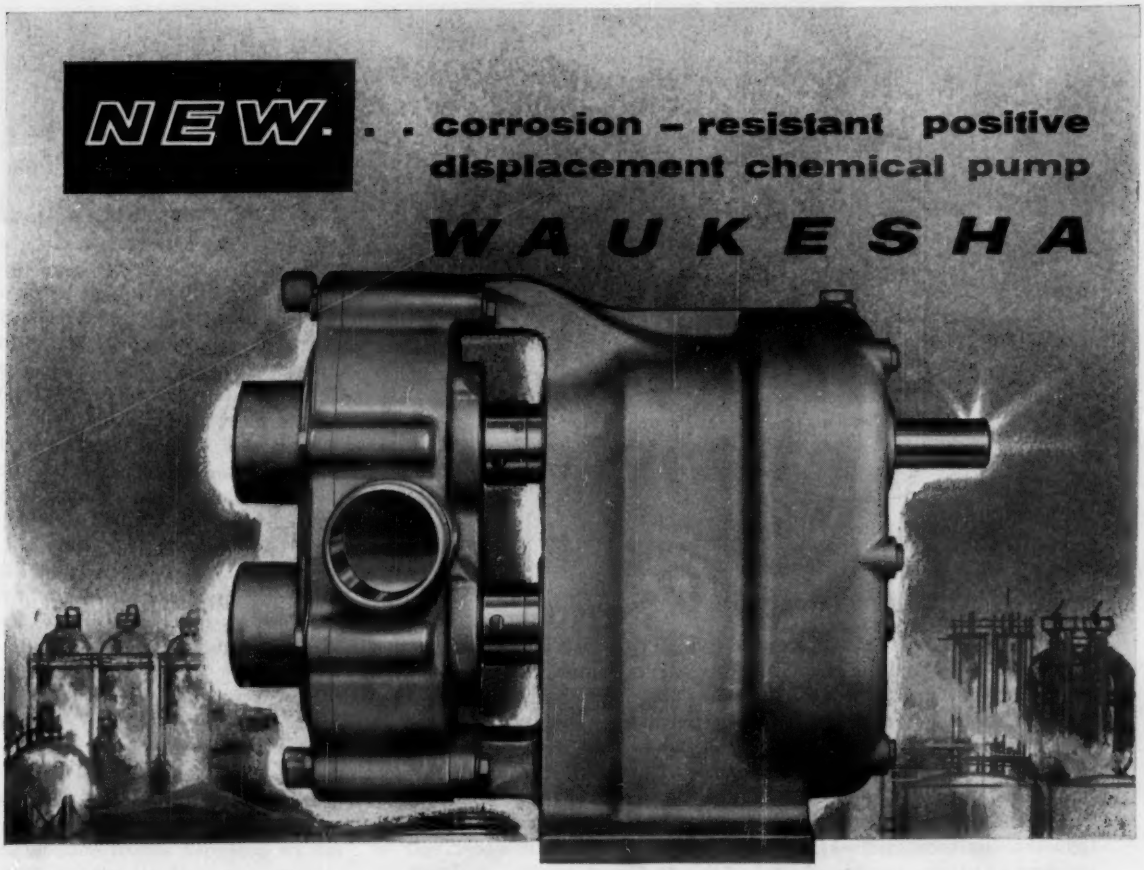
▶**ECM Needs U. S.**—Western European countries have made and will continue to make special efforts to attract U. S. capital for chemical ventures, not only because of a scarcity of capital in some countries but also, and more importantly, because their economies are too small to sustain the extremely expensive research necessary for the development of the chemical industry.

Indications are that U. S. companies should and will concentrate on those products that are heavily oriented toward research and technology, product areas that require very high research and development expenditures and in which U. S. firms occupy a unique position: pharmaceuticals, synthetic rubber, polymer materials and synthetic fibers. Other opportunities will be available for products that are difficult to export and ship great distances: liquid oxygen, dry ice, and many other cryogenic liquids and gases.

That the ECM may soon justify big investments in facilities serving a large market offers a real opportunity for large-scale manufacturing of bulk items: petrochemicals, plastics, synthetic fibers, synthetic rubber.

Mass selling techniques, a hallmark of U. S. industry, can also be put to work. These usually result in a faster growth of consumer-type products that are important chemically: i.e., detergents and synthetic fibers.

▶**For Better Living**—The outstanding conclusion reached at last year's A. D. Little-sponsored Arden House Conference on the ECM and the U. S. Chemical Industry was that the creation of the Common Market would accelerate the rise in the standard of living in Europe, which in turn seemed to promise continued accelerated growth for chemicals:




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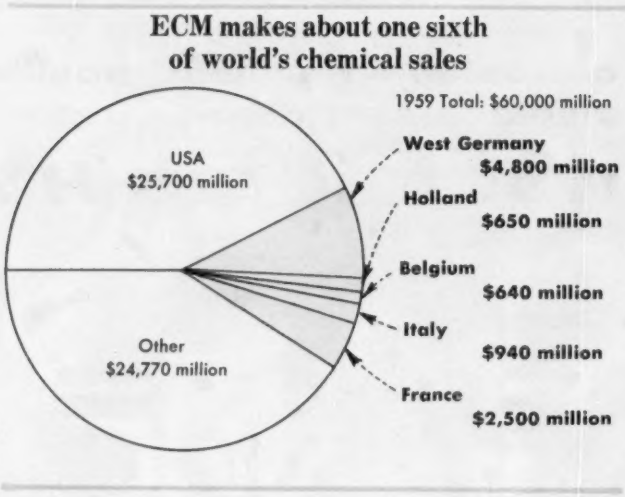
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• Principal growth opportunities would be found in chemicals related to the improvement of living conditions—products for the food, packaging, pharmaceutical, clothing, housing and transportation industries.

• Products for the automobile industry—finishes, rubber, fibers, gasoline additives, paints, oil additives—would also present very interesting growth opportunities, although perhaps not so important in the short terms as the industries mentioned in the previous category.

• The development of the petrochemical industry would probably be rapid, particularly in view of the greater availability of hydrocarbon raw materials in France and Italy (as well as from refineries in other countries). This factor, it was felt, may cause a general shift from coal-based chemical manufacture to petroleum-based synthetics.

• The general adoption of mass-selling techniques might contribute to a faster growth of consumer-type products that are chemically important.

At the Chemical Market Research Assn.'s recent European Chemical Industry meeting, H. G. Sinkel of Germany's Chemische Werke Huels, Jacques Roche of the Union of French Chemical Industries and Giulio Ballabio of Italy's Montecatini discussed the chemical industry outlook in their respective countries. Some of their remarks are abstracted below.

► **Germany**—The Federal Republic is the largest chemical producer of the European Common Market. Within Germany, the chemical industry ranks third among all industrial branches, preceded only by the food and machine-building industries.

*Capital Expenditure*—Total investments of the West German chemical industry amounted to approximately $415 million in 1959. This figure represented 8.4% of industry sales. Volume of 1959 investments was below that of 1958 because a labor shortage prevented vendors from meeting the requirements of the chemical industry for capital goods. A total of $476 million is expected to be invested during 1960.

Last year, investments centered on organic synthetics, with emphasis on the enlargement of petrochemical installations. Large portions of investments were borne by plastics, pharmaceuticals and synthetic fiber producers.

*Plastics*—In the manufacture of plastics, the Federal Republic ranks second in world production, although it is a considerable distance behind the United States.

The sudden rise in the production of polyethylene makes it by far the most interesting product. In Germany, the production of polyethylene and polypropylene rose from 6,500 tons in 1955 to 60,000 in 1959. By 1961-62, polyethylene capacity is expected to reach about 125,000 tons, consumption figures being identical.

*Fibers*—The noncellulosics' share in man-made fibers has been increasing steadily. German production, which started in 1950, reached a capacity of approximately 38,000 tons in 1959. Production in the United States grew from 55,000 tons to more than 290,000.

Polyamide fiber still ranks first in Germany. It is expected, on the basis of planned expansions, that polyacrylonitrile fiber will seriously compete with nylon fiber in the not-too-distant future. The same is true for polyester fiber, for which existing production facilities are hardly adequate to meet demand.

Production of rayon and acetate yarns in Germany is on the decline, though rayon and acetate staples have been able to maintain their positions.

*Synthetic Rubber*—Up to the second half of 1958, the rubber industry depended almost entirely on imports for synthetic rubber. Then Bunawerke Huels started operation of a styrene-butadiene cold-rubber plant. Initial capacity of 60,000 tons/yr. is now being expanded to 120,000. The second producer of synthetic rubber in West Germany, manufacturing neoprene and nitrile rubber, has also expanded its plant facilities considerably.

In the tire industry, natural and synthetic rubbers are used at a ratio of about 62 to 38. A shift in favor of synthetic is expected, however.

S-type rubber tops the consumption scale, followed by nitrile, butyl and neoprene. Plans are being made for production of polybutadiene and polyisoprene.

*Petrochemicals*—Behind Great Britain, Germany ranks second among the producers of organic petrochemicals in Europe. New investments rose from $173 million in 1957 to about $263 million in 1958. This trend towards high investments is expected to continue.

The rise in petrochemical production will not affect chemical production based on coal, as the latter

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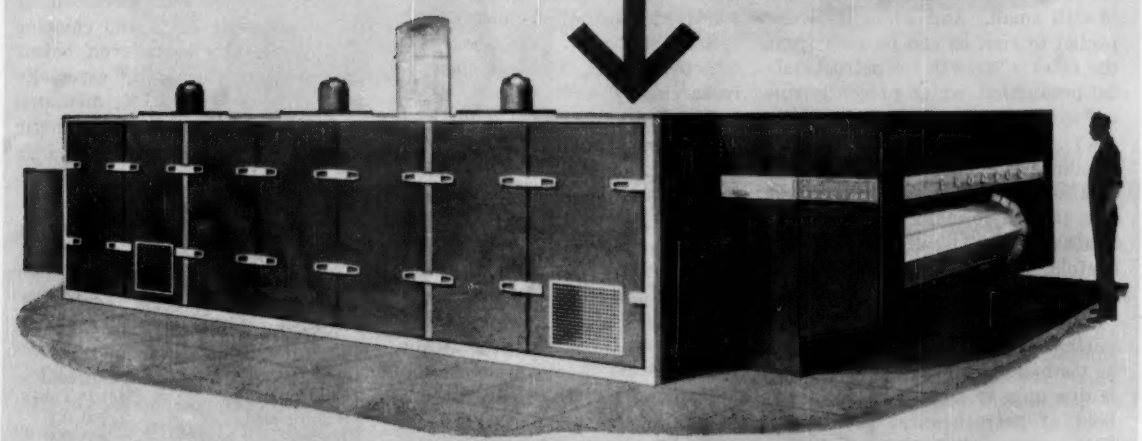
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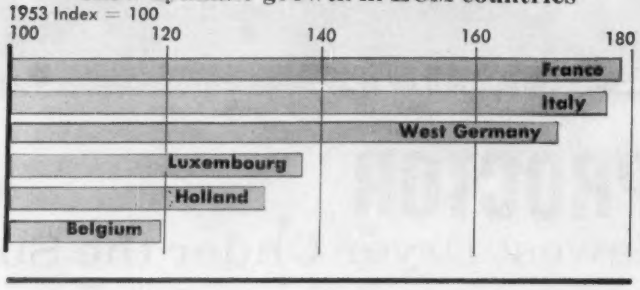
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**Indexes of chemical production for 1958 show dynamic growth in ECM countries**




industry alone would not have been in a position to meet the raw-materials requirements. Production of coke, coke gas, benzene and tar is dependent upon the production of steel and the rate of growth in the steel industry is considerably below that in the chemical industry.

Production based on crude oil and natural gas is still expected to rise, mainly in view of increasing demand in plastics and synthetic fibers.

Compared with the U. S., where the share of petrochemicals is 80% for organics, Germany's 40% share is still small. And while it is expected to rise, as can be seen from the rates of growth for petrochemical production, which presently run up to about 20% (U. S. growth: 5%), the advance is not expected to continue at this same high rate.

*Aliphatics*—During the last decade, German production of organic synthetics has increased almost fivefold. For several primary chemicals (e.g., ethylene) the rise has been even larger. The economic importance of typical aliphatics such as methane, propylene and butylene is due only to developments in the field of petrochemical production. For other aliphatics, including ethylene or higher hydrocarbons (propylene tetramer), the petrochemical basis was at least a principal element of their economic development. On the other hand, two other aliphatic chemicals of great importance, acetylene and carbon monoxide, still rely to a great extent on coal as raw material.

*Aromatics*—Within the last few years, domestic production has not been able to meet the demand for toluene and xylene, which has risen considerably. The gap has been filled by imports, mainly from the United States which, unlike Germany, already bases much of its production of aromatics on petroleum. Some aromatics have been petroleum-based in Europe, but only to a small extent in Germany.

► **France**—As a chemical producing country, France ranks second in the Common Market, third in Western Europe, and sixth in the world. France is the fourth largest world exporter of chemicals.

Sales last year were about $2.8 billion. Of this, 3% was spent on research.

The French chemical industry is much more spread out than that of other countries. The ten leading French firms account for 25% of the yearly turnover, whereas three German firms taken together account for 31%, and a single Italian company for 50%. But a trend to integration is under way.

The industry is now at a turning point because of the development of petrochemistry, the appearance of new resources in energy and raw materials, the trend to integration, expansion coinciding with the opening of the Common Market.

Large deposits of natural gas were discovered in 1939 at St. Marcet, near Toulouse, and have been used for twenty years for producing such chemicals as nitrogenous fertilizers. At Lacq, which belongs to Societe Nationale des Petroles D'Aquitaine, reserves of natural gas discovered in 1949 approach 10,600 billion cu. ft., two thirds of which can be recovered. Crude petroleum treated in French refineries increased from 7 million tons in 1938 to more than 30 million in 1958.

Capacity for olefin derivatives, which was about 151,000 tons in 1958, will amount to 326,000 tons in 1962. These derivatives will include a wide range of resins.

French production of diolefin derivatives will consist, for the most part, of synthetic rubber (butyl, nitrile and SBR) and acrylonitrile-butadiene-styrene resins, with capacity of about 80,000 tons/yr.

Capacity for aromatic hydrocarbon derivatives should reach 67,000 tons in 1962, up from 36,000 in 1958. Production of carbon black amounted to 30,000 tons at Berre last year. Capacity will rise to 100,000 when new plants at Port-Jerome and Bec d'Ambes are completed. Capacity for ammonia from fuel oil, refining and natural gases will nudge 400,000 tons in 1960.

Some production data can be given for the first six months of this year as compared with the corresponding period in 1959: production of sulfuric acid increased by 6.7%, ammonia 5.8% and chlorine 15.3%. Results seem even better for organic chemicals, especially with ethylene at 112.1%, methanol at 74%, acetone at 36.5%, synthetic phenol at 21.4% and PVC at 48.3%. Production of alkyd paints and varnishes climbed 14.7%. Increase in turnover for industrial chemicals, exclusive of paints and varnishes, amounted to 24%.

Production forecast for 1961, made by the official Plan Commission for Chemicals, follows:

| Product | 1961 est. (Metric Tons) |
|---|---|
| Sulfuric acid | 2,200,000 |
| Hydrochloric acid | 300,000 |
| Carbon disulfide | 46,310 |
| Nitrogen | 887,000 |
| Benzene & allied products | 214,000 |
| Organic intermediates | 194,673 |
| Acetic & formic chemicals | 453,305 |
| Plastics | 436,000 |
| Carbon black | 66,000 |

► **Italy**—Since the war, the raw-materials situation has been im-

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proving in Italy, owing to the discovery of important natural gas fields and deposits of bauxite ores and potassium salts. Some production of crude oil has also been started.

Natural gas in Italy is sulfur-free 98%-pure methane that is now widely used as a raw material for chemical purposes. The percent utilization of natural gas as a raw material for manufacturing chemicals in Italy is by far the highest, at 12%, in comparison with other countries. Methane presently meets about 10% of the national power need.

Production figures for the most important basic chemicals follows:

| Product | 1959 (Metric Tons) |
|---|---|
| Sulfuric acid (calc. 100%) | 2,053,000 |
| Nitric acid (calc. 36° Be) | 949,000 |
| Hydrochloric acid (20/21° Be) | 117,000 |
| Ammonia (100%) | 726,000 |
| Caustic soda (100%) | 343,000 |
| Sodium carbonate | 491,000 |
| Calcium carbide | 299,000 |
| Carbon disulfide | 46,000 |
| Acetic acid | 35,000 |
| Phenol | 11,000 |
| Methanol | 48,000 |
| Formaldehyde (100%) | 24,000 |
| Urea | 119,000 |
| Plastics | 253,000 |
| Hydrogen peroxide | 7,000 |
| Tartaric acid | 8,000 |
| Trichloroethylene | 33,000 |
| Organic colors | 15,000 |

*Fertilizers*—Italy's production of complex fertilizers reached 925,000 tons in 1959. Present capacity for fixed nitrogen is about 750,000 tons/yr. About 3,000 tons/day of potassium ore is now being produced and enriched on the spot by Montecatini, at newly discovered deposits in Sicily. Production will shortly go to 7,000 tons/day.

*Petrochemicals* — Production of petrochemicals, in terms of carbon content, in 1959 was 180,000 tons. Investments in the petrochemicals industry amounted to $123,000 in 1958, $54,500 in 1959 and an estimated $239,500 in 1960 through 1962.

*Plastics*—Italy's total production of plastics in 1959 was 253,000 tons. PVC accounted for 180,000.

Thermosetting resins are produced by Montecatini principally at Castellanza—phenolics, urea and melamine resins. Such thermoplastics as polyethylenes, polystyrene, isotactic polypropylenes and polyester fibers are produced at Ferrara. Acrylics and methacrylics are made at Rho, near Milan.

Further impetus to Montecatini's output of thermoplastics will come from a plant under construction at Brindisi to be completed by 1962. Able to process 1.5 million tons/yr. of crude oil, the plant will be the most important of its kind in Europe. Olefin polymers and copolymers and a wide range of solvents, aromatics, aldehydes, alcohols, plasticizers, etc., will be produced.

The Edison group has its largest chemical centers near Venice, in the Po Valley and in Sicily. They produce a wide range of intermediates and end-products, including polyvinyl chloride, polyvinyl acetate, polystyrene, acrylonitrile, plasticizers and olefins.

*Synthetic Rubber*—SBR plant has been operated at Ravenna since 1959 by ANIC, a company belonging to the government. Capacity is 80,000 tons/yr. at present, with an increase to 90,000 tons expected next year.—F. A.

## Monopoly in Melamines Charged by Government

The U.S. government has charged American Cyanamid with monopolizing interstate and foreign trade in melamines. The suit, filed in Federal District Court in October, charged violation of the Sherman Antitrust Act.

Six other companies were named as co-conspirators, but now are defendants. They are: Monsanto; Ciba, Ltd., Basle, Switzerland; Ciba Products Corp., Fairlawn, N. J.; British Industrial Plastics, Ltd., London; Societe des Produits Azotes, Paris; British Oxygen Co., Ltd., London.

The government charged that American Cyanamid, with aid of the co-conspirators, had monopolized trade and commerce in melamine and melamine-containing products since 1937.

Melamine is used by manufacturers of textiles, dinner ware, electrical apparatus, laminates and paper.

The government said the monopoly was set up by way of an agreement that world markets for the manufacture and distribution of melamine would be allocated, and that American Cyanamid was given power to determine who could make, use or sell the product in this country. According to the government, the company refused to sell dicyandiamide, basic raw material from which melamine is commercially produced, for use in the competitive manufacture and sale of melamine.

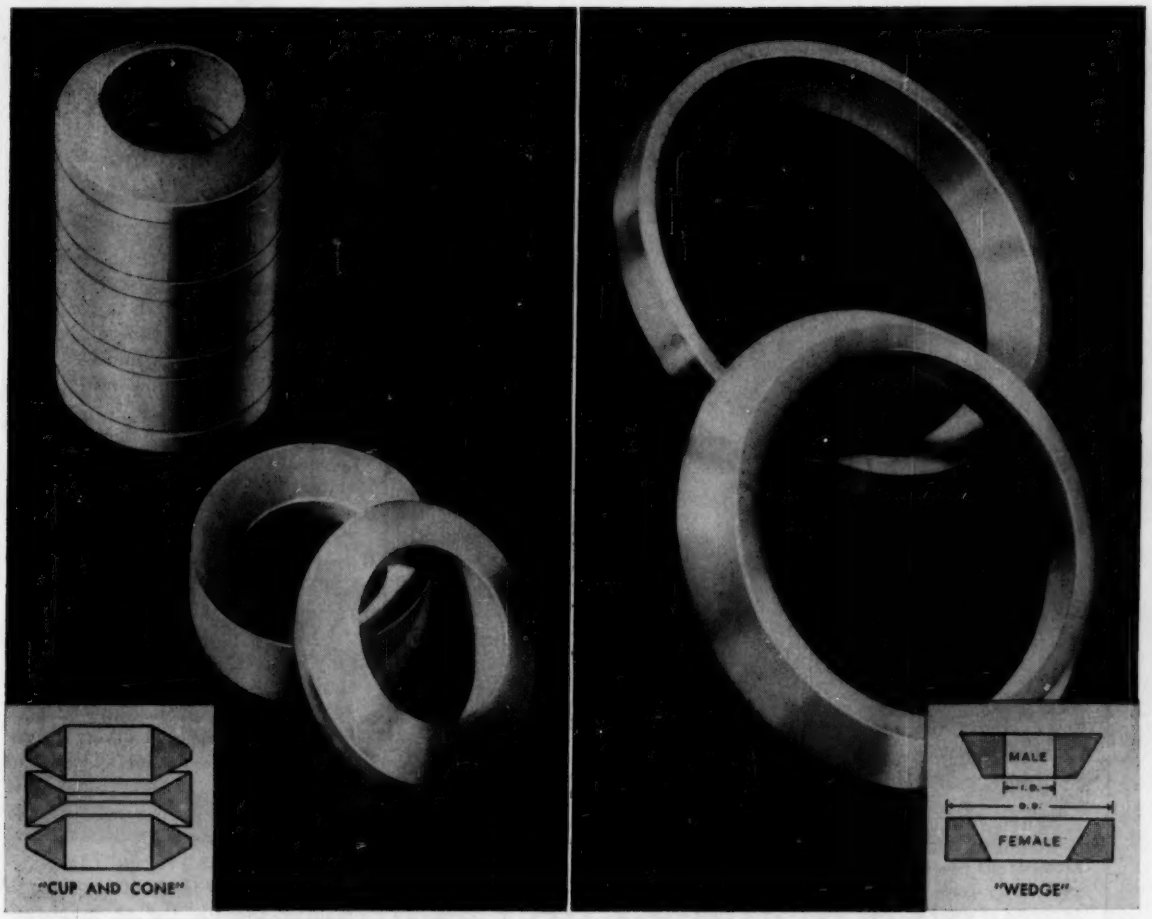
The company also allegedly adjusted the differential between the prices it charged for melamine and dicyandiamide "or threatened to do so" to discourage production of melamine by anyone else.

## Uses Mount for $CO_2$ In Liquid Form

New uses for liquid carbon dioxide as a coolant in industry have nearly doubled its production in the past five years, while output of harder-to-handle dry ice has dropped off.

C. E. Wolfe, vice president of Cardox division of Chemetron Corp., said recently that increased automation in industry has boosted liquid carbon dioxide consumption because the liquid is easily controlled and metered. In many instances, new devices and more efficient equipment have made it possible to introduce liquid carbon dioxide into processes where dry ice normally would have been used. This has resulted in increased ease of handling and cost savings.

Last year, 398,897 tons of liquid carbon dioxide were produced in the U.S., compared with 204,170 tons in 1955. Dry ice output dropped to 481,235 tons last year compared with 572,583 tons in 1955. Wolfe predicted that by the end of the 1960's dry ice would account for only about 25% of total carbon dioxide production.




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## Urethane foam makes boats unsinkable



*Quickly foamed in place with a spray gun, polyester urethane stiffens during expansion and permanently adheres to the hull and deck of a boat giving it structural strength and buoyancy.*

*As a new material of construction, rigid urethane foam also offers other advantages such as shock and sound absorption. The cushioning adds a tremendous amount of flex strength to the boat hull and deck and won't pull away from the boat body with the prolonged stretching and compressing of wave action.*

*A new Larson boat is reported unsinkable under most conditions; it can be filled with water and cut in half and still float. Brunswick Boats is enthusiastic and plans to use polyether urethane as the only type of flotation material for its 17,000 models going in production next year.*— **National Aniline Div., Allied Chemical, New York. 134A**

## Plasticizer

**Polymeric ester speeds vinyl formulations, simplifies handling.**

Compatible with both primary and secondary plasticizers, liquid Hatcol 640 can be used in combination to achieve desirable properties in milled, calendered and extruded vinyl products, as well as in plastisol applications.

Besides yielding unusually fast fusion rates in vinyl formulations, Hatcol 640 improves handling and cuts cost because of its low viscosity (18.3 poises at 25 C.) and low gravity.

This product also has an exceptionally low volatility and imparts good low-temperature properties to vinyls. As a general polymeric plasticizer, Hatco boosts resistance against oil, water, soap and hexane, provides good heat and weather resistance, prevents cellulose and lacquer migration. It is a stable compound with a flash point of 525 F. and a pour point of 7 C.

Hatcol 640 (8.9 lb./gal.) is available at 38¢/lb in 2,000-lb. lots, is making inroads in the manufacture of automotive film and sheeting, refrigerator gaskets, electrical tape, fabric coatings.—**W. R. Grace & Co., New York. 134C**

## Antifreeze Liquids

**Additives can lower pour point of heating oils by more than 70 F.**

Two new additives, Paradyne HO-10 and HO-20 now drastically modify the structure and size of wax crystals formed when a heating oil is cooled below its cloud or pour point. Even in concentrations of only 0.01-0.1%, these products lower the ASTM pour point of heating oils by 10 to more than 70 F.

Extensively tested during severe cold weather in northern Ontario and Maine, Paradyne HO-10 and HO-20 have eliminated handling difficulties that marketers and refiners had with high-pour stocks. Both additives offer greater freedom in adjusting operations and inventories to meet changes in demand. And they afford maximum use of high-pour stocks in heating oils by releasing low-pour stocks for use in other fuels.

Important savings are also realized. The cost of lowering the pour point of typical heating oils by 20 F. with Paradyne is often less than half the cost of using kerosene.

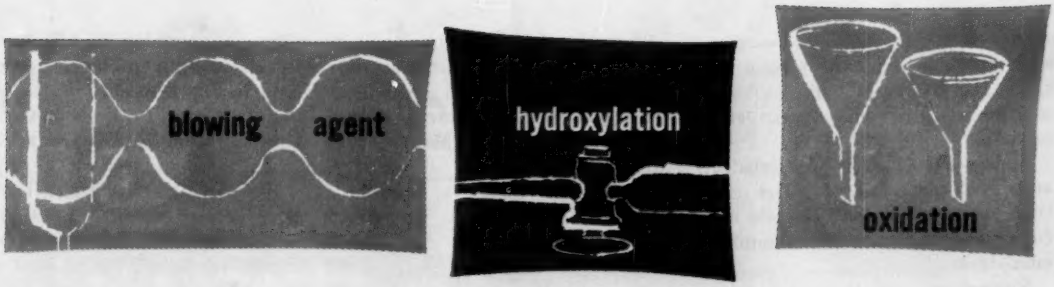
Both products are liquid at room temperature, can be handled like fuel oil and are compatible with other additives. They are commercially available at 75¢/lb.—**Enjay Chemical Co., Div. of Humble Oil & Refining Co., New York. 134B**

## Lubricant

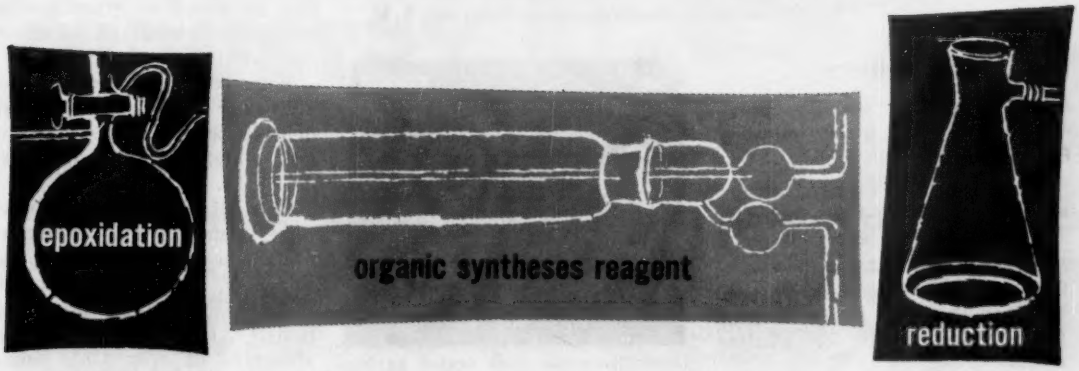
**Modified sperm oil emulsifies easily, protects metals.**

WGS Sperm Oil 42 provides all the desirable lubricating properties of ordinary sperm oil and forms permanent emulsions with as much as 95% water. In lubrication applications, these emulsions coat metals with strong protective films that won't wash off with water. When used as an additive, Oil 42 is economical because a small amount plates out a large area in a continuous monomolecular film.

This product can be reacted with chlorine or phosphorous to acquire high-pressure lubricating properties and it can be made water-




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soluble by sulfonation or reaction with ethylene oxide or strong alkalis. It is stable in acidic or basic solution and dissolves in petroleum solvents.

Sperm Oil 42 is a low-viscosity, amber-colored liquid with less odor than sperm oil, doesn't contain sulfuric acid, sulfonates or nonionic emulsifiers.

Suggested uses include cutting oils, steel rolling oils, textile and leather oils and petroleum additives.—**Werner G. Smith, Inc., Cleveland, Ohio.** 134D

## Emulsifiers

**Alkyl phosphates stabilize polymerizations, show good cleansing properties.**

Offered in the form of sirupy acidic esters at 98-100% activity, Phosphonol O, H, N and T are a new series of organic polyphosphates that show remarkable wetting, emulsifying and detergent properties in acidic or alkaline media.

These organic phosphoric acids have definite anticorrosive properties and exhibit chelating ability towards divalent or heavier metals. Slightly amber in color, they form clear to translucent solutions in water, dilute acids and alkalis while keeping their surface-active properties in the presence of heavy metallic ions.

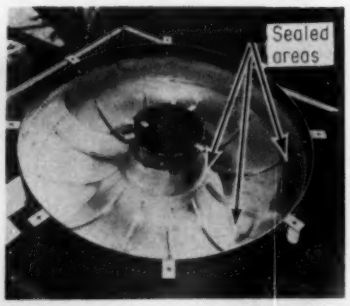
Compatible with anionic and nonionic surfactants, Phosphonols are used in liquid or powdered detergents along with alkaline builders. The more soluble members, Phosphonol H and O have good wetting properties in hard and soft water, and excellent wetting properties in 5-10% solutions of caustic soda or sulfuric acid.

Phosphonol N and T, which show less effectiveness as wetting agents, are recommended for heavy-duty cleaning compounds and emulsion polymerization. At 5% weight concentration, Phosphonol N has given stable dispersion of 10 to 50 millimicron particle size in styrene, acrylic copolymer and acrylic-styrene systems.

Phosphonols can also be used in textile scouring operations, pigment dispersions and antistatic agents.—**Beacon Chemical Industries, Inc., Cambridge, Mass.** 136A



North American Aviation's X-15




Liquid ammonia tank sealed against leakage.

## Structural Adhesive

**Elastomer welds supersonic aircraft components without increasing weight.**

Thermosetting film adhesive of the nitrile phenolic type, tradenamed Scotch-Weld AF 30, has solved sealing problems encountered in the assembly of the liquid ammonia tank in the North American Aviation X-15 research aircraft.

Surfaces of this aircraft utilize honeycomb construction design that allows the thin skin to carry the supersonic aerodynamic load while increasing strength and reducing over-all weight of the plane. Thin-gage metal braces and stiffeners create assembly problems because brazing is expensive and requires excessive heat, and holes for insertion of rivets or other fasteners weaken the metal and cause stress concentration.

Both honeycomb and thin-gage stiffener structures are feasible only if the materials are joined with a high-strength adhesive such as AF 30.

This adhesive prevents joint slippage, metal fatigue, enlargement of fastener holes and loosening of fasteners. Designed for metal-to-metal bonding and sealing operations, AF 30 provides shear strengths of over 4,000 psi. and possesses excellent flexibility and peel strength. The film has a uniform thickness of 10 mils, gives continuous contact through sealed joints and permits simple applications procedures.

Resistant to ozone, acids, water, jet fuels, ammonia and other deteriorating media, Scotch-Weld

Newsworthy Chemicals

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**Urethane foam** increases strength and buoyancy of boats.....134A
**Liquid antifreeze** additives simplify handling of heating oils.....134B
**Polymeric ester plasticizer** speeds vinyl formulations.....134C
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## FIREBRICK

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**HIGH BURNED SUPER DUTY FIREBRICK**

Fusion point 3220 F. This brick offers an excellent balance of properties to assure superior service. It provides approximately 5% more alumina content and lower total impurities than competitive brick. It has excellent spalling resistance.

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Fusion point 3250 F. Provides higher hot load strength than any competitive brick. Spalling loss is only 1%.

### KAO 70

**70% ALUMINA FIREBRICK**

Very low total impurities provide long life. Spall loss of only 2%.

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Use limit 3200 F. Alumina content—80%. This new ramming mix with extremely low permeability provides exceptional resistance to slag or molten metal penetration. High strength provides good erosion resistance.

### MULRAM EF

Use limit 3100 F. Alumina content—80%. Similar to Mulram E but supplied in finer grain.

### MULRAM CB

Use limit 3000 F. Alumina content —78%. A new chemically bonded dry ramming mix that provides greater strength at low temperatures, high modulus of rupture and excellent resistance to abrasion, slag and scale.

**FOR COMPLETE PROPERTIES SHEETS and additional information on these new B&W Refractories products, write to The Babcock & Wilcox Company, Refractories Division, 161 East 42nd Street, New York 17, N Y.**

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AF 30 also eliminates fume disposal and drying problems because it is solvent-free.—**Minnesota Mining & Mfg. Co., St. Paul, Minn.** 136B

## Synthetic Wax

**Boosts melting point of other waxes.**

Insoluble in all solvents at ordinary temperatures, Ross Wax 160 is a brown, hard wax with a melting point of 156 C. and a flash point of 310 C. It is compatible with paraffin and microcrystalline waxes, vegetable waxes, fats, esters, hydrogenated castor oil and rosin; added in small amounts to these waxes it raises their melting points considerably. Thus 10% added to paraffin wax raises the melting point to 142 C.

Its electrical properties and water resistance make it a good material for electrical applications in coatings, encapsulations, heat sealants and cables.

In powdered form, Wax 160 is a lubricant for drawing metal wire, and increases the moisture and salt spray resistance of paints and varnishes. In plastics, it can be used both as an integral lubricant and mold release. Insoluble in either hot or cold water, Wax 160 waterproofs and gives grease resistance to paper coatings, provides fiber lubrication in textile finishing.

Wax 160 is commercially available at prices ranging from 53 to 75¢/lb. for 2,000 to 25-lb. lots.—**Frank B. Ross Co. Inc., Jerey City, N. J.** 138A

## *Briefs*

**NaF single crystal,** grown by a vacuum process, is now available in very pure form. Suitable for windows in ultraviolet and infrared radiation detecting systems, it can also be evaporated as a thin film and used for reflection reducing coatings. This grade of sodium fluoride transmits light up to 12 microns in the infrared region and down to 185 millimicrons in the ultraviolet region. — **Semi-Elements Inc., Saxonburg, Pa.** 138B

**Thermosetting plastic** floor topping, Zelonide, is a dimensionally stable product with exceptional adhesive qualities and toughness that resists acids, alkalis, oils and greases. Zelonide bonds firmly to concrete, metal and wood, forming an impenetrable surface that withstands heat up to 212 F. It is recommended for floors where corrosive conditions exist.—**The Monroe Co., Cleveland.** 138C

**Para - chlorothiophenol** is now commercially available in 55-gal. steel drums. A versatile intermediate, it undergoes condensation reactions with aldehydes, ketones and esters. It oxidizes to the disulfide or sulfonic acid. With halogens, it forms the sulfonyl halides, reacts with amines to yield thioethers, with nitriles to form aminothioesters.—**Stauffer Chemical Co., New York.** 138D

**Reinforced Teflon** with ceramic fibers was used in the second stage of the recently launched Discoverer XIII as beacon antennas. The material was selected because of its electrical properties and ability to wear away uniformly under the tremendous speeds, pressure and temperature changes met during orbiting and when leaving and entering the earth's atmosphere.—**Rogers Corp., Rogers, Conn.** 138E

**Vinylidene chloride copolymer,** now sold as an aqueous dispersion called Resyn 3,600, gives coatings that are highly resistant to strong acids, alkalis and most solvents. Used as a textile finish for industrial fabrics and as a binder for non-woven fabrics, Resyn 3,600 is internally plasticized and yields continuous films at room temperature without added plasticizer.—**National Starch & Chemical Corp., New York.** 138F

**Hydrous calcium silicate,** called Micro-Cel T-38, is a white powder used as pigment in emulsion paints to provide high hiding power. About 30 to 35 lbs. of Micro-Cel can replace 40 to 50 lbs of titanium dioxide per 100 gals. without loss of opacity, giving a saving of approximately $10/100 gals. of paint. Micro-Cel is also a flatting agent useful in reducing angular sheen. — **Johns-Manville Corp., New York.** 138G

**Chromium-alumina catalyst,** C30, developed for dealkylation processes, specifically for conversion of toluene to benzene, is now commercially available at $25-30/cu. ft.—**Catalysts & Chemicals Inc., Louisville, Ky.** 138H

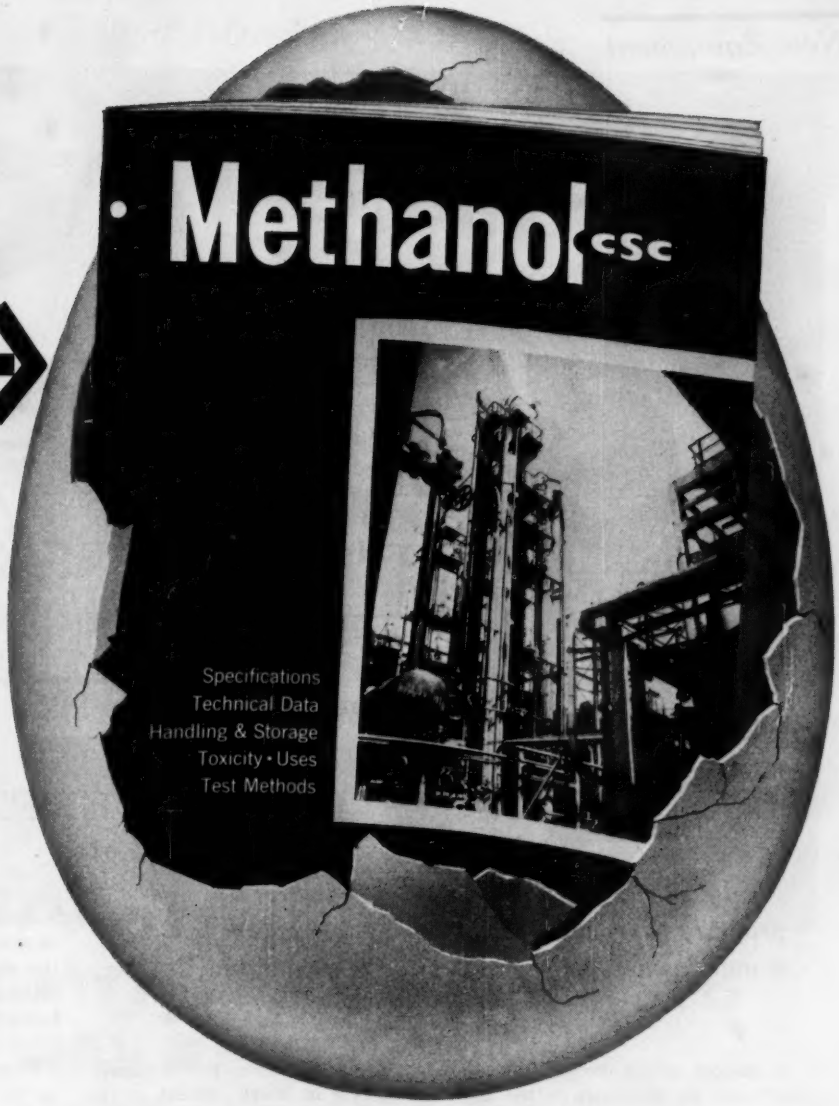
**Lead-filled plastic** sheet developed as a new radiation protective shield or curtain, can be laminated to paper, wood or metal, cut and sewn to make protective clothing against ultraviolent and infrared exposure.—**Crowl Chemical Co., El Monte, Calif.** 138I

**Insulating foamed plastic,** called Rigid Armaflex, is a load-bearing material for pipe hanger and deeply buried pipelines. Impervious to moisture, self-extinguishing and ozone resistant, Rigid Armaflex is available for pipes up to 3 in. IPS in prematched half sections 3 ft. long.—**Armstrong Cork Co., Lancaster, Pa.** 138J

**Intermediate for urethane foams,** Niax hexol LS-485, is a new hexafunctional derivative of propylene oxide that gives increased crosslinking density to polyether foams because of its low molecular weight of about 700 and high functionality. Niax is an useful intermediate in the preparation of various resins, emulsifiers, pharmaceuticals, adhesives, plasticizers, surfactants and biocides.—**Union Carbon Chemicals Company, New York.** 138K

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(Page 295)

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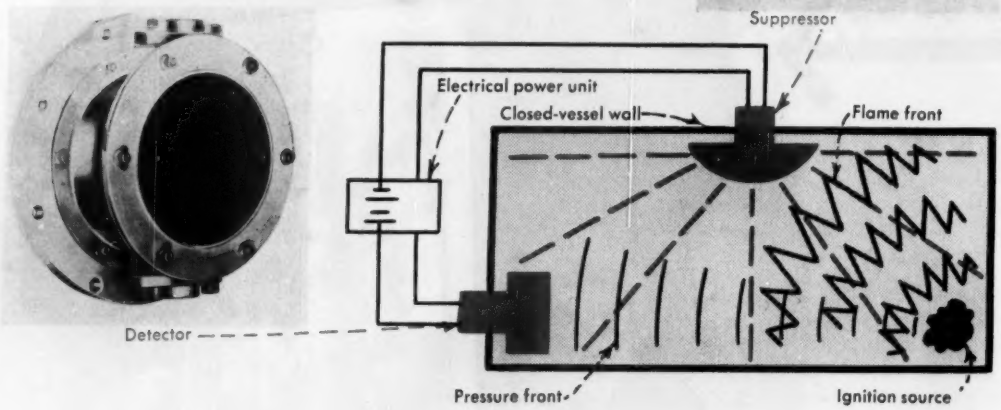
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Key components bottle up blasts






# SUPPRESSOR SYSTEM NIPS EXPLOSIONS

***New device meets the challenge to protect life and property in process operations. System acts so fast that it nullifies an explosion after the blast occurs.***

A modern safety device that can snuff out an explosion *after* the blast has been triggered sounds like scientific legerdemain. Actually, it works; on one recent occasion it nipped an explosion in a plastics grinding mill without any outward evidence of the trouble. Before the mill was protected, a similar occurrence split the mill open and ripped out a nearby wall.

Developed by Fenwal Inc., Ashland, Mass., the system is aimed at reducing the tremendous loss in property damage (estimated at $100 million in 1958) and irreparable human toll that result from industrial explosions and the fires that frequently follow.

Designed to work in pulverizers and mills, enclosed tanks, dryers and reactors, the system comprises three units—a detector, a suppressor, and an electrical power supply.

▶ **Detector at Work**—Heart of the system is the detector. Either a pressure or radiation device, it senses an incipient explosion, generates an electrical signal.

Pressure units are sensitive to either rate of pressure rise, to a specific static pressure, or to both. A signal is generated when pressure rise from an incipient blast exceeds either setting, indicating an explosive condition.

Radiation detectors are designed to selectively sense certain wave lengths of the spectrum that exist in an explosive flame, but to reject others present in natural or artificial light.

The power supply acts as a link between the detector and the suppressor or other protection devices in the system. Standby batteries protect against power failure.

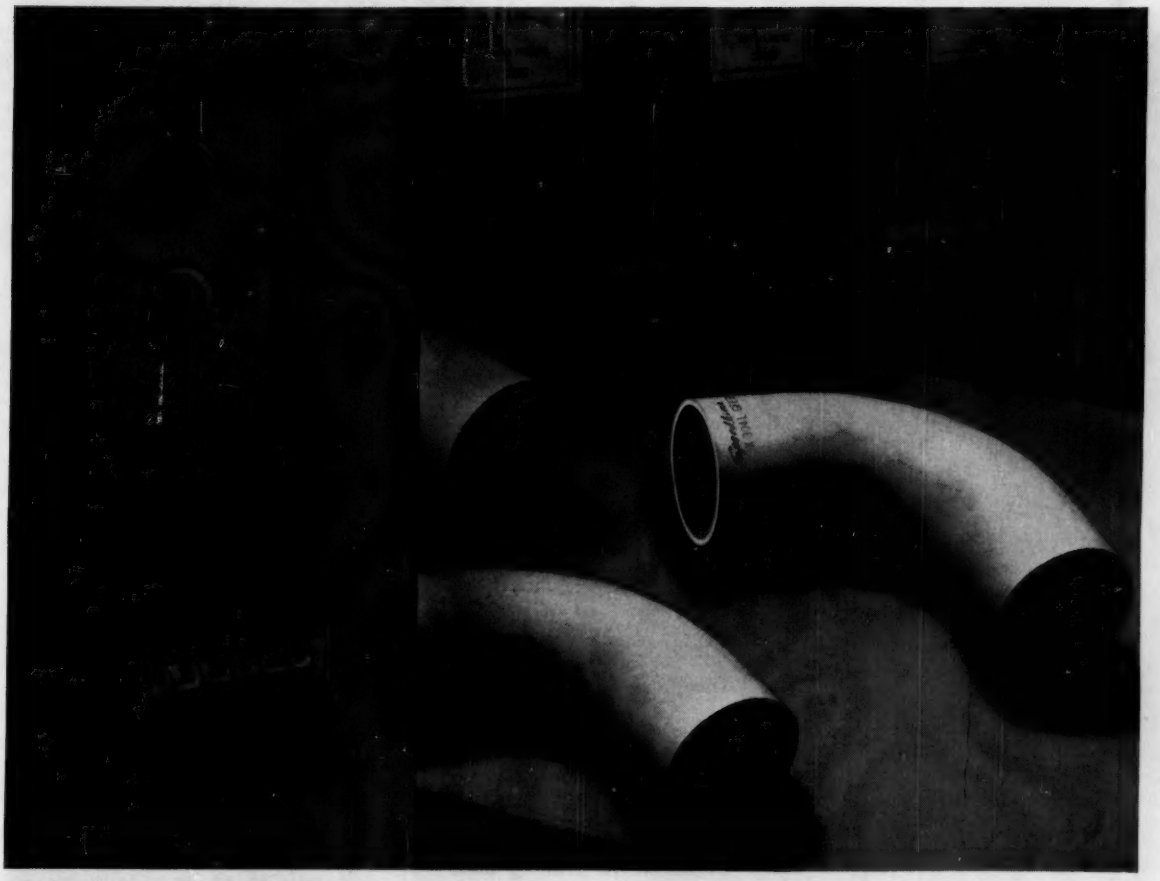
After the detector does its work in spotting the initial presence of the explosion, it is up to the suppressor to squelch the budding blast before it develops into a full-scale eruption.

▶ **Two Types**—Suppressors come in two styles: a bursting hemisphere and a high-rate discharge bottle. Fastest acting and most direct is the hemisphere, filled with suppressant surrounding an explosive charge.

When the detector signals a need, it fires the charge electrically. The hemisphere bursts along a petal-shaped pattern scored on its surface, ejects the enclosed liquid at speeds up to 600 ft./sec. The same ejection speeds are obtained from the high-rate discharge bottles, which are also fired explosively.

The incipient explosion is cooled by evaporation of the enveloping mist of suppressant, which inhibits further combustion. Water and various halides such as bromochloromethane are most frequently used in the suppressors. Only 5 cc.

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# Speedline® FITTINGS ARE MADE TO MEET CRITICAL STANDARDS

Now you can comply with the severest codes and save up to 50% on *critical* stainless steel process lines when you specify SPEEDLINE Fittings and economical light wall Schedule 5 or 10 pipe.

The new issue of Code for Pressure Piping ASA B31.3-1959, for example, allows a *design pressure* of 611 psi for 2″ ips Schedule 5, Type 304L process pipe at 100°F. Under the same conditions, allowable design pressure for 1½″ ips pipe would be 768 psi; for 1″ ips, 1122 psi.

Since SPEEDLINE Fittings have been specially designed for use with light wall pipe, they can result in substantial installation economies whether you plan to butt-weld, flange or socket-join your lines. Yet *long tangent* SPEEDLINE Fittings cost no more than other fittings which are suitable for "non-critical" service only.

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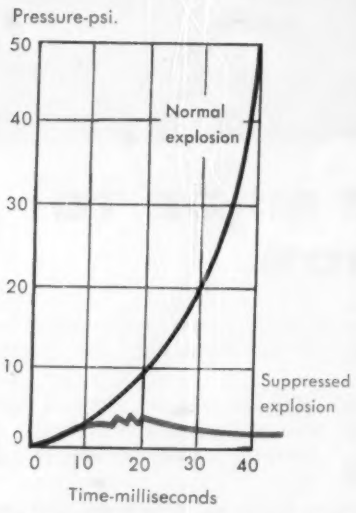
STAINLESS STEEL • ALUMINUM • SPECIAL ALLOYS

A PRODUCT OF HORACE T. POTTS COMPANY • 500 E. ERIE AVENUE • PHILADELPHIA 34, PENNSYLVANIA

of water or 2 cc. bromochloromethane can protect one gallon of tank space.

► **Other Defenses** — Two other types of defenses can be operated to protect equipment and personnel. Operating from the same type of detector, a vent can be explosively opened to provide a large area that can expend the built-up pressure. The vent seal is usually a glass window which is shattered by a detonator mounted on its outside face. The force of the incipient explosion insures that fragments will fly outward, away from the protected space.

Also, areas of a process can be isolated from a dangerous region by butterfly or flap valves. Valves are held open against heavy spring pressure by a hollow metal link. When an incipient explosion activates the detector, it fires an explosive detonator lodged inside the link, breaking it and allowing the spring to slam the valve closed.

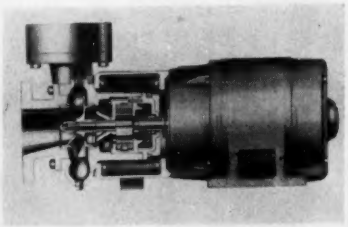



► **Fast Acting**—It is apparent that the key to the success of the system is in timing. The explosion must be snuffed within 0.1 sec. or it will be completely out of hand. As shown in the graph, the time from the first inkling of trouble received by the detector until the suppressor sprays the trouble spot and quenches the buildup is less than 30 milliseconds.

Originally developed to protect aircraft fuel tanks against incendiary shells during World War II, the system has been used in England for many years. No explosions have occurred in protected equipment there, according to Fenwal. It has been used in half a dozen places in this country, with at least one incipient explosion being nipped, as noted above.

Thus far, the system is used only to protect against oxidation-type explosions, although research is continuing on the problem of blasts occurring as faster-acting decomposition reactions. System costs $5,000 to $10,000.—**Fenwal, Inc., Ashland, Mass.** **140A**

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## Self-priming pump

**Centrifugal type has positive-displacement priming unit.**

Combining the lifting capabilities of a self-priming pump with the efficiency of a standard centrifugal, a single-stage, single suction unit will prime under suction lifts of 19-ft. total head.

Pump is set up with a check valve on the discharge piping. The priming unit runs on the same shaft as the impeller, acts like a centrifugal air compressor. Rotating vanes in an eccentric chamber (which contains residual liquid from previous pumping) suck air in from the suction system, push it out into discharge piping, downstream of the check valve.

When liquid reaches the regular impeller, normal pumping begins. Some liquid goes through the primer unit, replenishing any of the priming liquid that may have been lost due to evaporation, and lubricating the mechanical seal on the shaft.

Called Motorpump, new unit comes in 5-, 7½-, 10- and 15-hp. sizes with a 3-in. discharge line. Capacity ranges to 600 gpm., heads to 120 ft. Integral check valve on pump discharge is optional.—**Ingersoll-Rand, New York.** **142A**

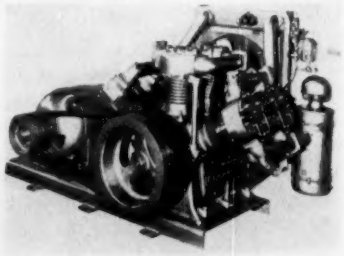
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## Water treatment plant

**Package unit adds components for degree of treatment wanted.**

The emphasis on modular construction so pronounced in the electronics field is reaching into other equipment areas, viz., water treatment. Components that once were custom designed for each installation are now packaged in off-the-shelf form, to be used to build water treatment systems in the range from simple softening to ultrapure water preparation.

Packaged units are available to remove carbon dioxide, oxidize ferrous iron or hydrogen sulfide, soften, remove turbidity, chlorinate, filter and provide other treatment. Systems can treat from 10 to more than 100 gpm., mostly on a completely automatic basis. Manufacturer says custom designs, now made compact and standardized, can be joined for any degree of water treatment.—**Pfaudler Permutit Inc., Permutit Div., New York.** **142B**



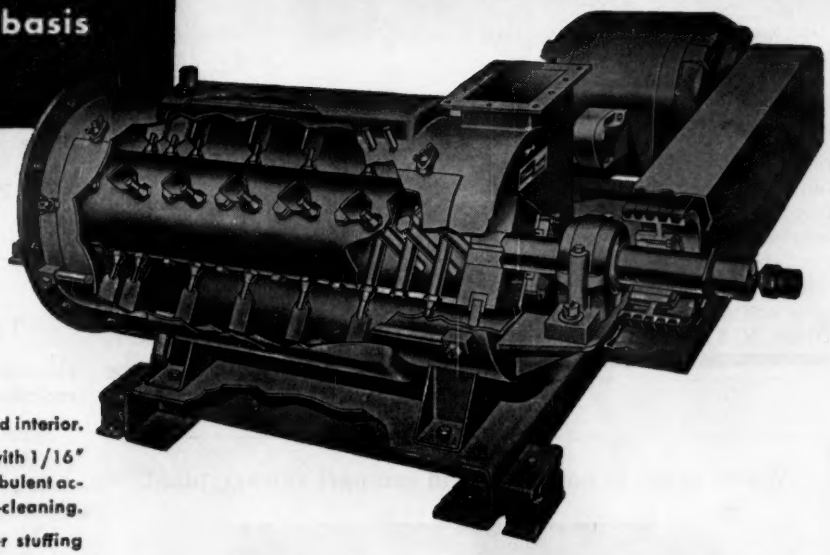
## Air compressor

**Two-stage air-cooled units are compact, lightweight.**

Designed to be compact and lightweight, a new line of air compressors is completely air-cooled to eliminate weight of a water

There's one sure way to get intimate mixing of dry and semi-dry material on a continuous basis

# Strong Scott TURBULIZER®



## EXCLUSIVE TURBULIZER FEATURES

- Heavy steel shell with machined interior.
- Paddles revolve at high speed with 1/16" clearance to shell, creating a turbulent action that makes Turbulizer self-cleaning.
- Choice of lip type, air purge or stuffing box seals. All are of split construction for quick disassembly. (Lip type seal shown.)
- Hinged door is machined as an integral part of the shell giving a perfectly smooth interior surface.
- May be equipped with jacket up to 150 PSI for heat transfer medium.
- Hollow rotor shaft for heat transfer medium gives added temperature control.
- Inlet nozzles available for adding liquids.
- Quick acting heavy lug type catches—no nuts or bolts to remove.
- Tangential inlet and discharge prevent material hang-up.
- Heavy duty outboard bearings.
- Rotating joints for easy connection to heat transfer medium source.

The Turbulizer solves many dispersion problems in the chemical and food industries. Adjustable-pitch paddles, revolving at high speed, result in the combined action of turbulence, shear and impact providing intense dispersion. These actions can be varied to obtain desired results on a specific material.

A completely smooth inner surface with 1/16" clearance paddles, assures thorough mixing, eliminates material hang-up, leaves no dead pockets of unmixed material and provides a self-cleaning operation.

In addition to the numerous features shown here, advantages of the Turbulizer include better product uniformity, increased production, plus lower labor, installation and up-keep costs.

*Write for complete details...*

Please send information on the Turbulizer

NAME_____

TITLE_____

COMPANY_____

ADDRESS_____

CITY_____ STATE_____

The Strong Scott Mfg. Co.

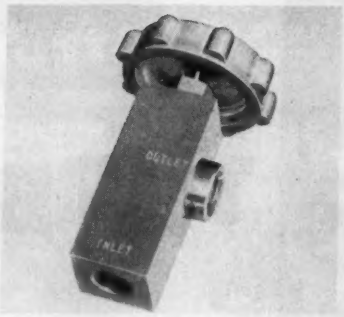
451 TAFT STREET NE • MINNEAPOLIS 13, MINNESOTA

EQUIPMENT DESIGNED FOR BETTER PROCESSING

jacket. Ranging from 25 to 100 hp., compressors can be bolted directly to a good concrete floor or mounted on a relatively thin concrete slab.

Compressor cylinders are said to operate at conservative piston speeds to assure long operating life. Both high- and low-pressure cylinders, single-acting type, are individually removable. Four cylinder sizes cover the complete line.

Fin and tube intercoolers have copper alloy core sections that can be easily removed for cleaning or replacement. An induction-type fan, belt-driven by the crankshaft, forces air through the cooler and over the cylinders. Compressor is available mounted on base with or without motor; and also without base and motor.—**Clark Bros. Co., Olean, N. Y.** 142C




## High-pressure valve

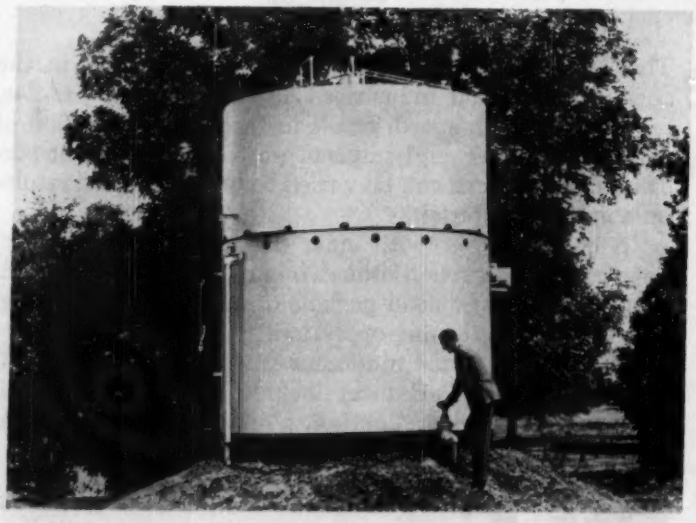
**O-Ring seal said to make new valve completely leakproof.**

A new high-pressure shutoff valve, featuring full-flow passage and O-ring sealing, is right-angle type for mounting convenience. Suitable for almost any gas or liquid service from 0-6,000 psi., it operates over the temperature range of −40 to +450 F.

Seal design, said to give zero leakage at all pressures, engages a machined stem into a resilient O-ring. A spring-loaded sleeve follows the stem as it is withdrawn, enclosing the O-ring and protecting it against extrusion and cutting action of liquid flow. Gradual flow throttling is possible.

Stainless steel construction is supplemented with various O-ring formulations. Valve is available with single inlet and outlet; or single inlet, double outlet; or double inlet, single outlet.—**Circle Seal Products Co., Pasadena, Calif.** 144B

## Waste space is not wasted in compact sewage plant



*The tank above is filled with waste space, every inch of which is put to work processing waste sewage. Named Bio-Pac, the compact unit is designed to serve industrial plants of 50 to 500 persons in locations where municipal sewage treatment is not provided. Said to be fully automatic, the Bio-Pac is a two stage, bio-filtration plant patterned on a treatment process commonly used in full-scale installations. Cost per capita ranges from $60 to $240, depending on size of unit used. Present design is not suited for industrial wastes, will handle only domestic sewage.*—**Link-Belt Co., Chicago.** 144A

## Fire-detection tube

**Electronic tube sees ultraviolet radiation, reports fire.**

Sensing a narrow band of ultraviolet radiation, prominent in flames but not in natural or artificial light, a new electronic tube is the heart of a series of systems for fire, smoke and flame-out detection. The tube operates in the range from −75 to +400 F., cannot be triggered by infrared or cosmic radiation.

As a fire-detection unit, the tube is faster acting than heat-activated devices which must literally feel the heat of the flames before they sound the alarm or turn on the sprinkler. With proper circuitry, the bulb not only can sound the alarm but also can activate sprinklers (and turn them off after the flames have subsided).

Its operating principle is reversed for flame-out applications, so that it signals when a flame is

*(continued on page 274)*

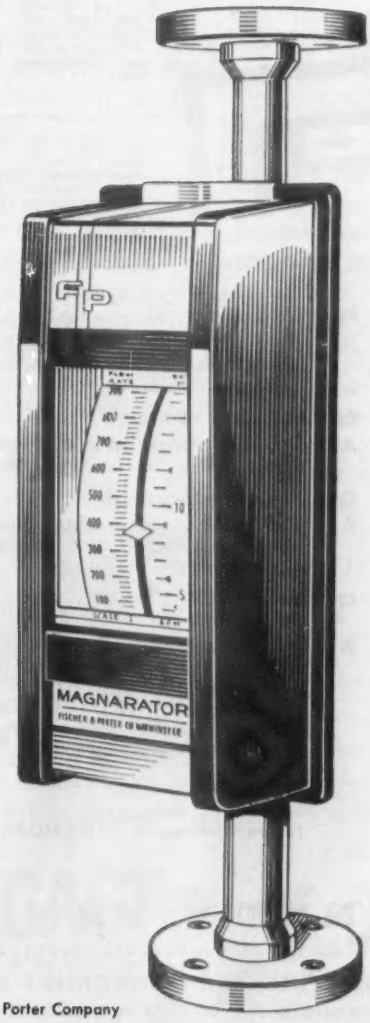
**For More Information**

about any item in this department, circle its code number on the

**Reader Service Postcard**

Page 295

■ The Magnarator* is a metal or glass tube rotameter that clearly indicates flow rate and transmits a linear pneumatic output signal as well. But it is a true in-line, through-flow meter . . . no nooks, crooks, crannies, or corners. Magnarators have no fear of the most troublesome liquids and gases. Even problem slurries flow directly through without hesitation. The motion balance transmitter is a design that has proved itself inherently accurate and dependable time and time again. And in the Magnarator it is at its very best. This is an outstanding companion to our present extension-type Magnabond* flow transmitter.



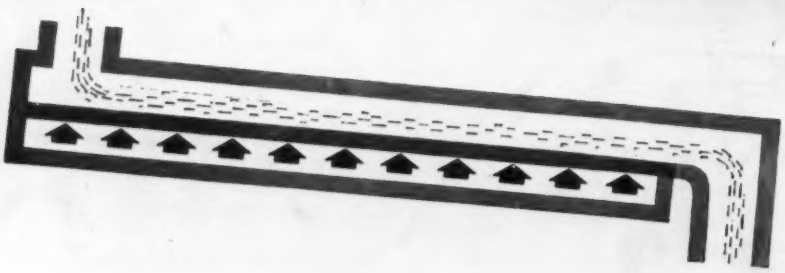

*Hardly a process exists*
*that would not benefit by the installation*
*of several Magnarator instruments.*
*Look about you and the right spots*
*will surely jump to your attention.*
*Liquid ranges: 1 to 100 gpm water equivalent.*
*Gas: 4 to 400 scfm air. Details in*
*Catalog 10A2150. Fischer & Porter Company,*
*210 County Line Road, Warminster, Pa.*

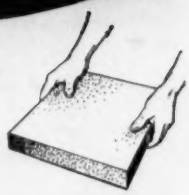
**Fp**
**FISCHER & PORTER COMPANY**
*COMPLETE PROCESS INSTRUMENTATION*

*Tradename of Fischer & Porter Company

# AIR FLOAT

the better-built, more efficient air-gravity conveyor provides the answers to Dry Solids Conveying





The special porous plate is exclusive with KENNEDY AIR-FLOAT. It is strong, resistant to abrasion and temperature and has a smooth surface texture.



Sections are ruggedly designed, formed on modern production equipment and completely assembled before shipment.

**Q.** How does AIR-FLOAT work?

**A.** *The dry material to be conveyed is fed on to a smooth, rigid, porous plate through which low pressure air continuously diffuses. Because the conveyor is inclined about 6 to 8°, the aerated material flows by gravity.*

**Q.** What distinguishes the KENNEDY AIR-FLOAT from other air-gravity conveyors?

**A.** *Primarily, the special porous plate. Also the casing is of heavier construction, flanged and channeled for greater rigidity.*

**Q.** How is this special plate better than other porous media?

**A.** *The AIR-FLOAT porous plate has literally millions of tiny pores through which the air diffuses uniformly for thorough aeration of the conveyed material. The plate is thicker, stronger, temperature- and wear-resistant, and has a very smooth surface texture.*

**Q.** How does this improve conveying?

**A.** *AIR-FLOAT has a much higher capacity than competitive air-gravity conveyors. Blind spots are eliminated and the angle of inclination is less critical.*

**Q.** What about maintenance?

**A.** *The KENNEDY AIR-FLOAT is the nearest thing to a completely maintenance-free conveyor that has ever been devised.*

**Q.** Can turns be made?

**A.** *Direction changes up to 45° are made with standard pieces. These can be combined for greater angles.*

**Q.** Are accessories available?

**A.** *Yes. End and side discharge boxes, splitters, control gates, transitions, bin extractors and required blowers can be provided.*

**Q.** Have KENNEDY AIR-FLOAT Conveyors been fully tested and proven?

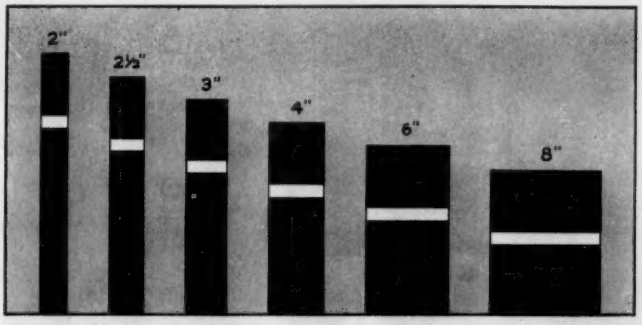
**A.** *Yes. For more than 12 years AIR-FLOAT Conveyors have been successfully used in KENNEDY-designed cement and lime plants. With this background of experience, KENNEDY is now making AIR-FLOAT available to industry, mass producing it to sell at competitive prices.*

**For more information on AIR-FLOAT, ask for Bulletin 58-K.**

**KENNEDY VAN SAUN**

**MANUFACTURING & ENGINEERING CORPORATION**

405 PARK AVENUE, NEW YORK 22, N.Y. • FACTORY: DANVILLE, PA.

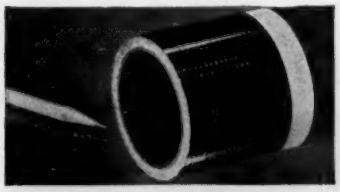



Choose from 6 sizes. Same operating temperature range . . . same operating pressure range . . . same corrosion resistance . . . NEW 6- and 8-inch sizes meet the growing demands of the processing industries.

# Now! A complete size range of Fibercast Epoxy Pipe—including new 6″ and 8″

- *handles a temperature range from 65° to 300° F.*
- *withstands an operating pressure range up to 1200 psi.*
- *pipe sizes from 2″ to 8″*

Only Fibercast, with its unique reinforced epoxy resin construction, can withstand sustained high pressures, high temperatures and extreme corrosive conditions more efficiently than any other pipe. Fibercast's ability to competently handle 320 of 338 corrosive solutions is on record. And now Fibercast, in answer to more of the needs of industry, brings its proven value to larger size flow lines.

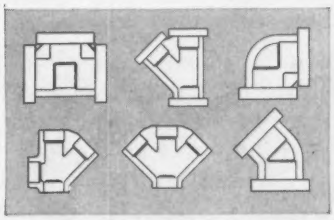


Fibercast Tube and Pipe, ranging in size from 2″ to 8″, is not subject to cold flow or permanent set. It is exceptionally easy to install, readily following ditch contours, saving many costly man-hours where other non-metallic pipes or coated metal pipes simply do not work effectively.

The operating collapse strength of Fibercast is another major factor in its wide-spread use. It has a proven capability of maintaining a collapse load of *twice* the rated collapse!* Moreover, Fibercast is much lighter than steel (less than ¼ its weight) and is correspondingly easier to handle, during both installation and maintenance.

**An additional safety factor is that Fibercast, with its seamless woven glass fiber construction, cannot burst.*

Fibercast Fittings, of course, are also available for the new sizes. They represent the world's most complete stock of standard sizes and types. And, as always, you can have couplings, or even complete piping systems, designed and made to order for your individual requirements.



Get the full story on Fibercast's cost-saving advantages to industry. Learn how it can help *you* solve *your* pipe and tube problems. Mail the coupon today.

**FIBERCAST COMPANY**
**Box 727, Sand Springs, Okla.**

Please send me further information about Fibercast Tube and Pipe. CE-11A

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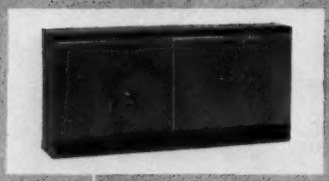
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City _____ Zone _____ State _____

**FIBERCAST®** COMPANY

A DIVISION OF THE **Youngstown** SHEET AND TUBE COMPANY

# BENDIX G-20



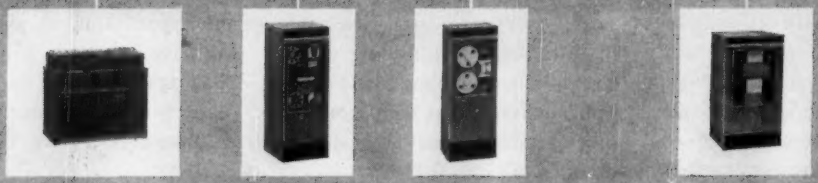
## WITH ORGANIZATION CHART DESIGN



## MEANS PRACTICAL EXPANDABILITY IN



## BALANCE WITH APPLICATION GROWTH



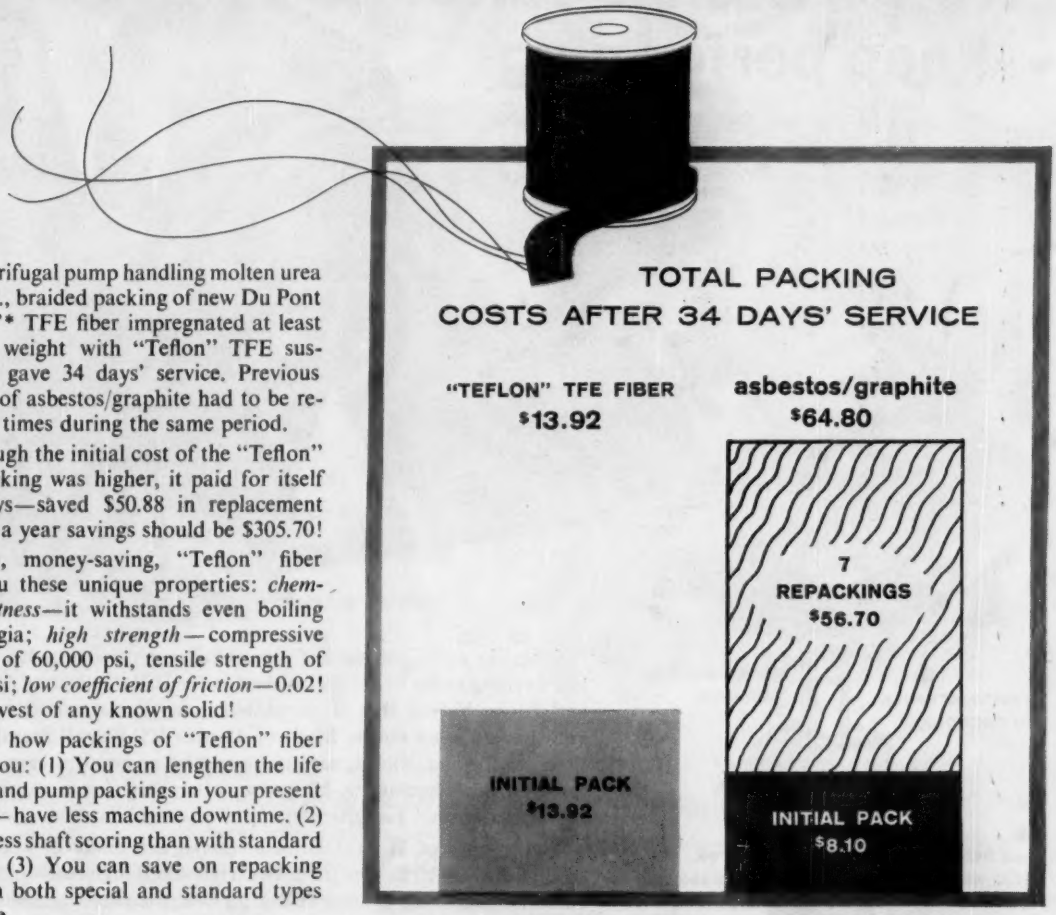
Just as the organization chart of any enterprise provides the framework for dynamic growth and adaptation, so "organization chart" design provides the framework for unparalleled expandability in the Bendix G-20 data processing system. This means that your G-20 can economically match, step by step, your expanding scientific or business computational workloads ...without sacrificing system balance. • Key to the organization chart efficiency of the Bendix G-20 is the ability of the Central Processor to "delegate" routine data handling tasks to control buffers, acting as "line supervisors." Thus freed, the Central Processor can make most efficient use of its high computation speed, its ability to schedule program priorities and direct accessory equipment assignments. • The ability to employ many control buffers gives new meaning to expandability in the Bendix G-20. Up to 70 input/output units can be directed by each of these "line supervisors." The Bendix G-20 has a complete line of accessory equipment including keyboard, paper tape, punched cards, high speed line printers, and 2 million word magnetic tape units. • Memory represents another dimension of G-20 expandability, ranging from 4,096 to 32,768 words. • Investigate the organization chart design of the Bendix G-20. See how it provides balanced, *practical* expandability...at a cost that assures unequalled data processing performance per dollar invested. • ***For detailed literature write:***

Bendix Computer Division
DEPT. G-27 LOS ANGELES 45, CALIFORNIA

THE Bendix CORPORATION

# Braided packing of new TEFLON® TFE FIBER

## pays for itself in 8 days, saves $50.88 replacements costs




In a centrifugal pump handling molten urea at 130°C., braided packing of new Du Pont "Teflon"* TFE fiber impregnated at least 35% by weight with "Teflon" TFE suspensoid, gave 34 days' service. Previous packing of asbestos/graphite had to be replaced 7 times during the same period.

Although the initial cost of the "Teflon" fiber packing was higher, it paid for itself in 8 days—saved $50.88 in replacement costs; in a year savings should be $305.70!

Tough, money-saving, "Teflon" fiber gives you these unique properties: *chemical inertness*—it withstands even boiling aqua regia; *high strength*—compressive strength of 60,000 psi, tensile strength of 50,000 psi; *low coefficient of friction*—0.02!—the lowest of any known solid!

Here's how packings of "Teflon" fiber benefit you: (1) You can lengthen the life of valve and pump packings in your present process—have less machine downtime. (2) There's less shaft scoring than with standard packing. (3) You can save on repacking costs—in both special and standard types of service.

*"Teflon" is Du Pont's registered trademark for its TFE-fluorocarbon fiber.

For a free sample and more information about braided packing of new Du Pont "Teflon" TFE fiber—its properties and applications—fill out, clip and mail the coupon below.




**DU PONT "TEFLON" TFE FIBER**

DU PONT
REG. U.S. PAT. OFF
BETTER THINGS FOR BETTER LIVING
...THROUGH CHEMISTRY

E. I. du Pont de Nemours & Co. (Inc.)
Textile Fibers Department, 31K1 Centre Road Building, Wilmington 98, Delaware

Please send me my free sample of braided fiber packing of Du Pont "Teflon" and new folder. I am interested in using this new packing material for_____

Name_____ Position_____

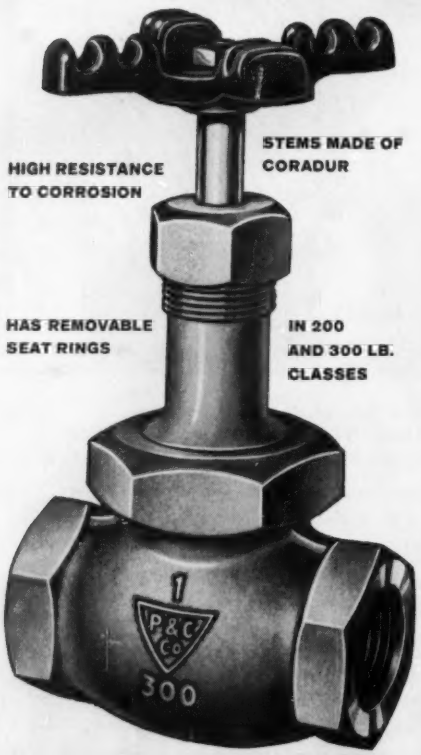
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City_____ State_____




# "R-P&C Bronze Valves keep performing like new"




"Valves, like any vital piece of plant equipment, must be kept in top working order at all times. And with R-P&C Bronze Gate and Globe Valves this is no problem, for these valves have **renewable seat rings.** Made of durable 500 Brinell Stainless Steel, or Copper Nickel, seat rings can be screwed in or out if replacement is necessary. Moreover, when servicing is required, the union bonnet permits fast, easy access to internal parts."

The **stems** of R-P&C Bronze Valves are made of special Aluminum Silicon Bronze (**CORADUR**) to afford high resistance to corrosion and seizure. Their **full plug** design makes them ideally suited for throttling in steam, water, oil and/or gas service. Air-cooled, **cross-type handle** gives added ease of operation.

These features, and many others, are available with R-P&C Bronze Gate and Globe Valves in the 200 and 300 pound classes.

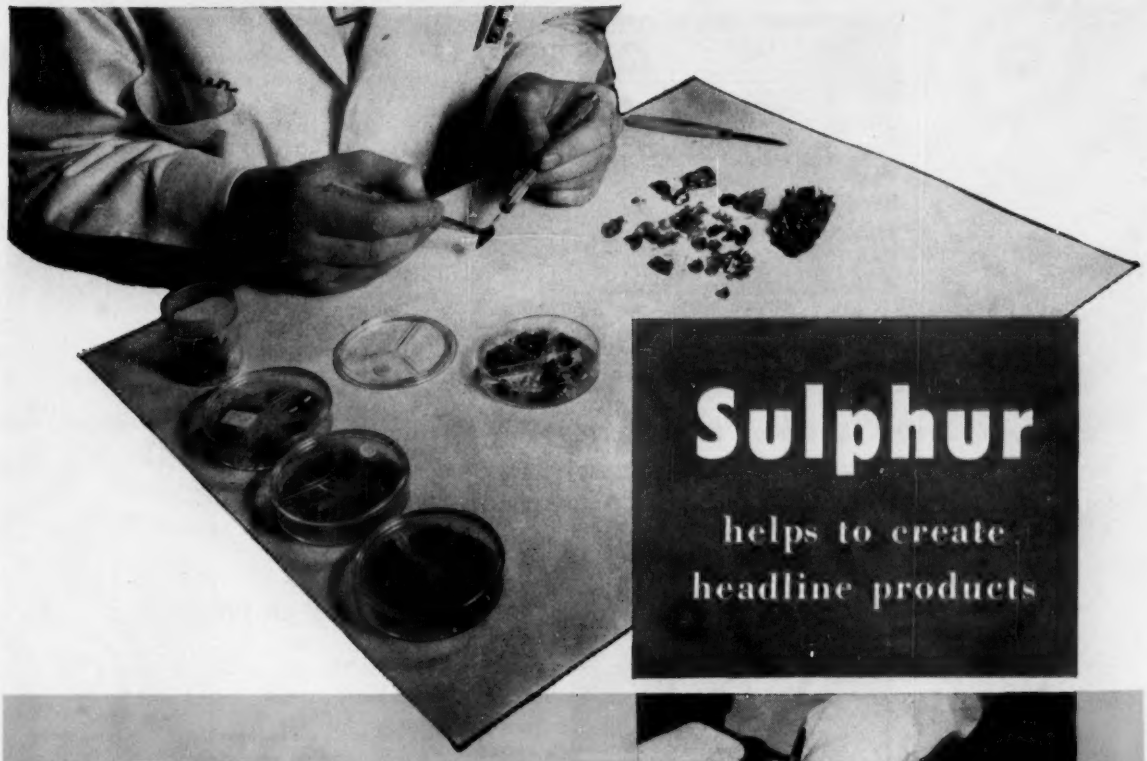
**Contact your R-P&C distributor** for complete information about these valves as well as R-P&C's complete line of electric furnace iron, cast steel, bar stock and forged steel valves.

## R-P&C VALVES

ACCO

**R-P&C Valve Division, American Chain & Cable Company, Inc.**

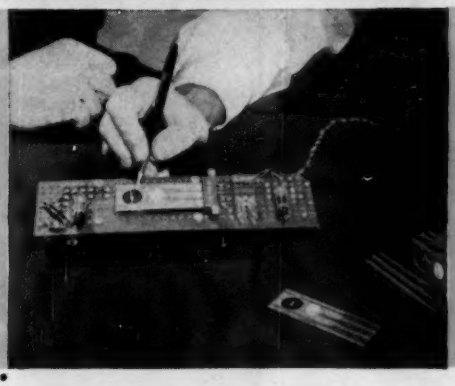
Reading, Pa., Atlanta, Boston, Chicago, Denver, Detroit, Houston, New York, Philadelphia, Pittsburgh, San Francisco, Bridgeport, Conn.



# Sulphur

helps to create headline products

## CdS • • • a new concept in field-effect transistor design



General Motors Research Laboratories has recently announced the application of a new transistor material ... the cadmium sulphide crystal which offers several distinctive values over the single type atomic material. Its outstanding characteristic is that it is controllably sensitive to and affected by light and other radiations.

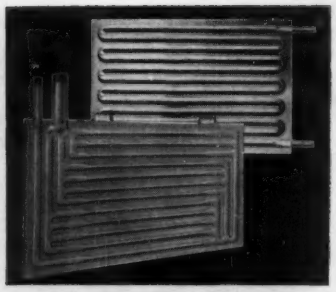
CdS provides another interesting development where Sulphur is importantly in the picture ... a development that may have far-reaching effects in the broad field of electronics.

**Sulphur** and its many derivatives, either directly or indirectly, have a part in the creation of countless products, adding to the strength of our economy. Our business is to produce Sulphur—molten as well as solid—and have it available in sufficient tonnages at several departure points to serve any plant in the United States or Canada. Supplementing this basic policy, we are developing centralized distribution centers for quicker service.

**TEXAS GULF SULPHUR COMPANY**

75 East 45th St., New York 17, N. Y.
811 Rusk Ave., Houston 2, Texas

*Sulphur Producing Units:* Newgulf, Texas • Spindletop, Texas • Moss Bluff, Texas • Fannett, Texas • Worland, Wyoming • Okotoks, Alberta, Canada

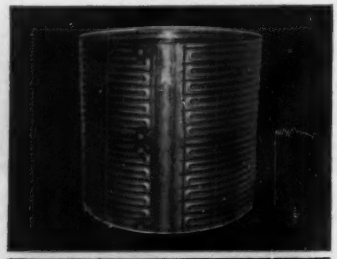


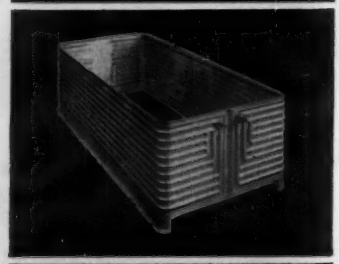
# PLATECOIL®

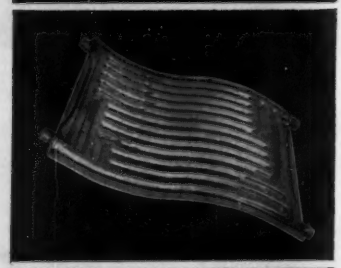
"STANDARD" STYLES OR SPECIALLY FORMED AND FABRICATED

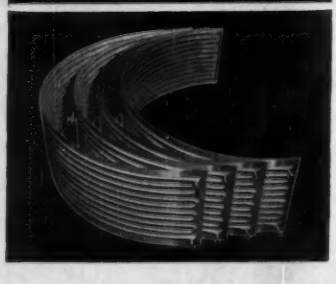
# =a SOLUTION

TO DIFFICULT HEAT TRANSFER PROBLEMS









Now you can apply the engineering, installation, operational and maintenance advantages of PLATECOIL to more tank and process heating and cooling problems than ever before. Standard units with exclusive "MULTI-ZONE" pass design for faster heat-up and temperature recovery or serpentine pass arrangement satisfy many requirements. These "standard" styles, available in a wide variety of sizes can be factory-fabricated into banks to fit the application. PLATECOIL can be formed and rolled to specified diameters or even fabricated to form tank walls.

PLATECOIL provides a "packaged" answer to many heat transfer problems, avoiding costly engineering and fabricating of pipe coils. Units are easy to install and maintain—with simple connections, light weight, and streamlined surfaces. High heat transfer capacity permits compact, space-saving units.

Both "standard" and specially built PLATECOIL are available in mild steel, stainless steel, Inconel, Monel, Ni-O-nel, Hastelloy B, C and F, Nickel and other weldable materials. Operating pressures up to 250 psig. Safety factor—5 to 1. Double embossed or one side flat. Complete engineering data and assistance available.




Ask for Bulletin P61.

Tranter Manufacturing, Inc.

LANSING 9, MICHIGAN

PLATECOIL® DIVISION





## Who cares about your Wire Cloth Fabrications?

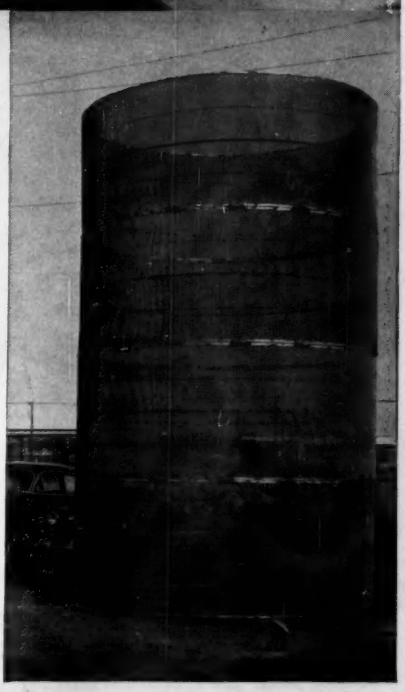
*CAMBRIDGE does . . .*

that's why you automatically get service with your order . . . whether you need dozens of midget strainers or a single giant-sized retaining screen.

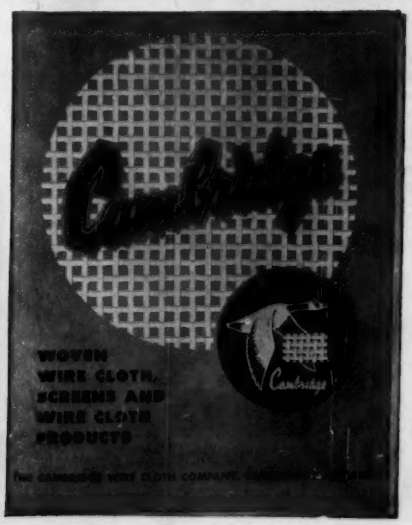
Careful, competent workmanship and constant inspection assure you of quality . . . modern machinery and accurate scheduling assure you of prompt delivery. And, a Cambridge Field Engineer follows up your order to make sure our product is giving you the best possible service. Let us quote on your next order for wire cloth fabrications. We manufacture wire cloth from any metal or alloy—including titanium—in nine basic weaves. We'll work from your prints or draw up prints for your approval. Call your Cambridge Field Engineer . . . he's listed in the yellow pages under "Wire Cloth". Or, write for FREE 94-PAGE CATALOG.

**The Cambridge Wire Cloth Co.**

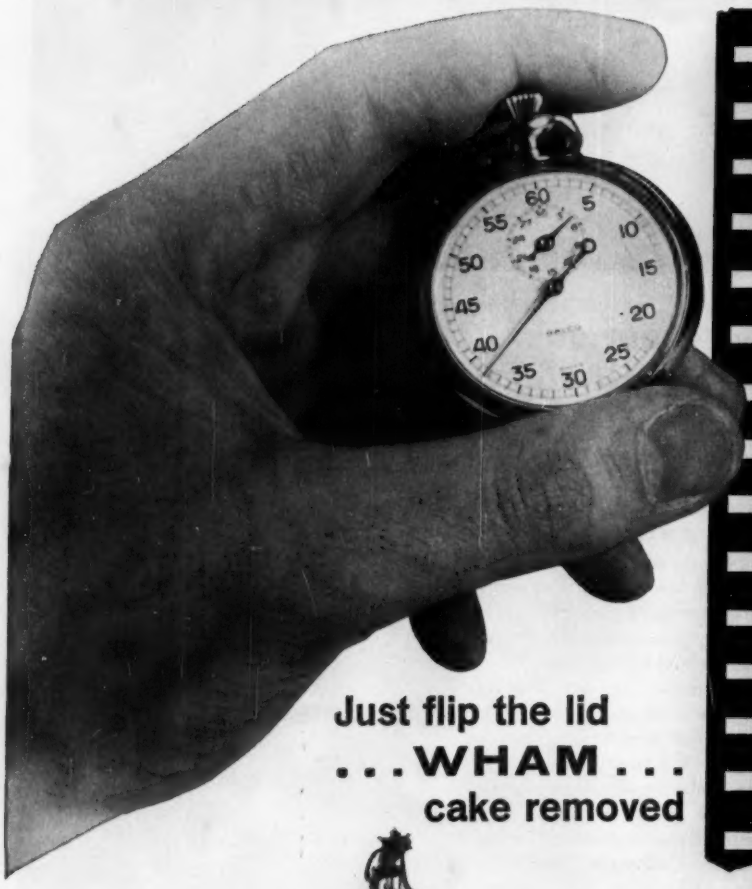
Department G • Cambridge 11, Md.
*Manufacturers of Wire Cloth, Metal-Mesh Conveyor Belts, Wire Cloth Fabrications*

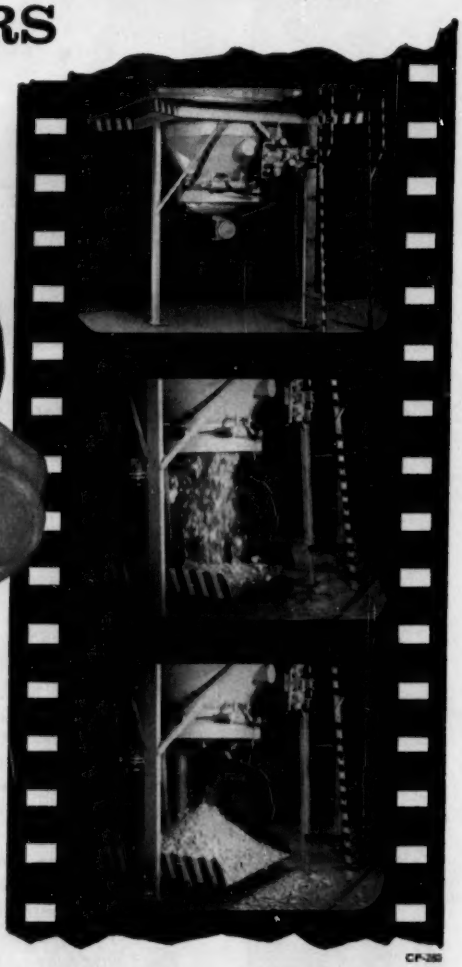




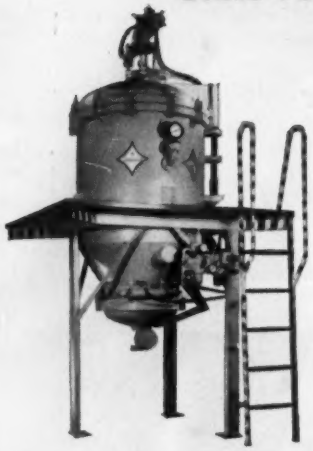


# SAVE TIME and EFFORT WITH MODERN FILTERS

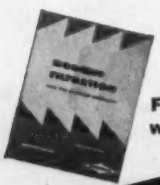




**Just flip the lid**
**...WHAM...**
**cake removed**



These rapid cleaning devices on INDUSTRIAL filters offer tremendous advantages to the user through removal of, and subsequent disposing of waste materials or recovery of valuable solids.



**For additional information write for Bulletin EP-100.**

With VIBRA-SHOC or RECIPRO-SHOC, cleaning of your INDUSTRIAL filter is completed in minutes. The above mentioned trade named devices are obtainable on INDUSTRIAL'S TYPE 152 filters, as are such optional equipment as QUICK OPENING COVERS, LIQUID SHOC and AIR WASH, all designed with the efficiency you require for your particular operation. All these mechanical aids work for you to realize a definite cost savings based on reduced downtime, for either continuous or batch type operation. These self-cleaning devices also eliminate the manual dirty work in handling any dry, wet or semi-solid material.

**INDUSTRIAL**

**INDUSTRIAL FILTER & PUMP MFG. CO.**
**5918 West Ogden Avenue, Chicago 50, Illinois**

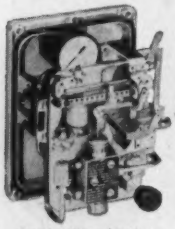

HOW Nosey, THE ESSO SOLVENTS EXPERT, WORKED MAGIC WITH SOLVESSO® XYLOL
There was trouble on the assembly line. Sticky, dull finish picked up dirt... smelled terrible.
What you need is faster film setting, higher solvency and better odor... in short, Solvesso Xylol!
Constant research on "low odor" Esso Solvents enables us to deliver fresh, uncontaminated solvents from modern, conveniently located terminals
SOLVESSO XYLOL
Esso
If you need help with your production problems, contact our nearest Esso office! (And tell 'em Nosey sent you!)
Esso
PETROLEUM SOLVENTS
ESSO STANDARD,
Division of Humble Oil & Refining Company
15 West 51st Street, New York 19, New York
In Industry after Industry..."ESSO RESEARCH works wonders with oil"



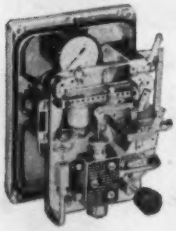
Recording Unit for Variable 1



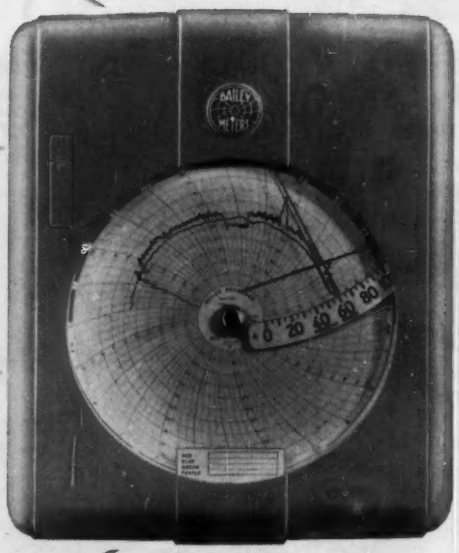
Recording Unit for Variable 2



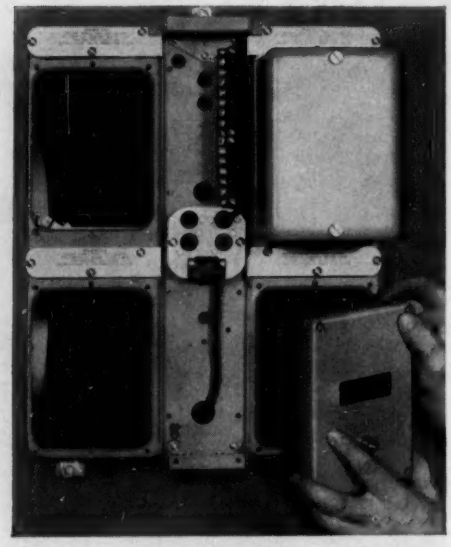
Controlling Unit for Variable 1



Controlling Unit for Variable 2



Back of Bailey Recorder, showing how four plug-in units may be added as needed.



*Key to "step-by-step" automation . . .*

# BAILEY RECORDERS

## *with plug-in flexibility*

When you are pioneering a new process and don't know all the answers, complete automation is seldom practical. The first step is to identify your variables and measure them. Nothing does this job better than a Bailey Recorder. One instrument can record any four variables that can be converted to electric *or* pneumatic signals.

Then you will want to add controls and feed back your measurements. Here's where the versatility of the Bailey Recorder comes into play. For the same Bailey instrument you use to record variables is designed to accommodate plug-in control units.

When you use a Bailey Recorder, you can build your instrumentation along with your process. At the start, you use only the plug-in units for recording. Then you add plug-in controls as you see the need for them.

For the complete story of how you can use a Bailey Recorder for step-by-step automation, contact your local Bailey Engineer.

CP111-1

***Chemical and petroleum division***

**BAILEY METER COMPANY**

1054 IVANHOE ROAD • CLEVELAND 10, OHIO

In Canada—Bailey Meter Company Limited, Montreal

BAILEY METERS

# CUT FUEL BILLS 20% WITH A LJUNGSTROM® AIR PREHEATER



*The world's largest fluid catalytic cracker at Esso's Bayway Refinery is equipped with a new Ljungstrom Air Preheater. This picture shows the half-ton cold-end elements being installed in the Ljungstrom rotor.*

Your biggest refinery operating expense is the money you burn: fuel costs. You can chop fuel bills ⅓ with a Ljungstrom Air Preheater, and here's how:

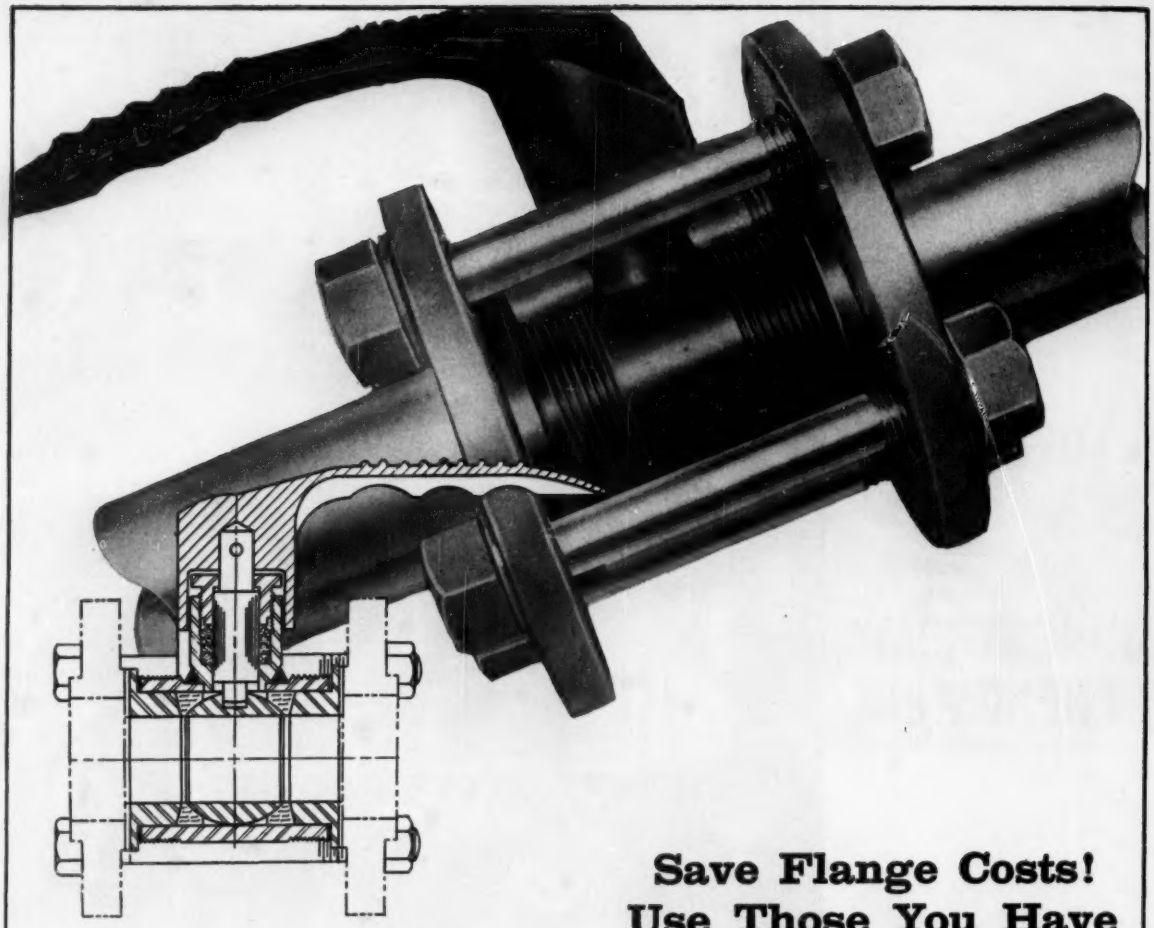
Your fuel bill drops about 1% for every 45-50°F you raise the temperature of combustion air. Ljungstroms now in service raise the air temperature 1000°F or more – and the rest is simple arithmetic. With a Ljungstrom, four barrels of fuel do the work of five. On fuel savings alone, one eastern refinery came up with net savings of $67,800 in the first year they used a Ljungstrom.

**SAME FUEL, MORE HEAT.** Ljungstrom economy is flexible economy. If total throughput is more important to you than fuel savings, a Ljungstrom can help boost the capacity of a pipe still at least 10% a day, without any increase in fuel consumption.

**THESE ARE FACTS** backed up by 25 years of Ljungstrom performance in refineries all over the world. But they're not the only facts. To find out about Ljungstrom's low-cost maintenance, easy inspection, in-service cleanability, space-saving compactness, call or write The Air Preheater Corporation for a free copy of a brochure called "The Ljungstrom Air Preheater for Process Equipment."

## THE AIR PREHEATER CORPORATION

*60 East 42nd Street, New York 17, N. Y.*



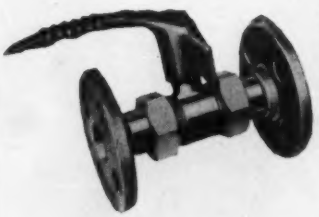
# Save Flange Costs! Use Those You Have

*Install Fullport Compression-Mounted Ball Valves in Seconds*

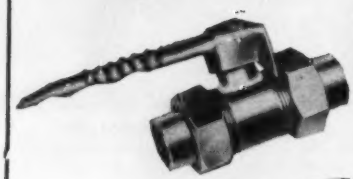
Fullport Compression-Mounted Ball Valves Model #8009 slip between the flanges of your present piping system with a minimum of down time. These valves which have the largest turbulence free port openings of any ball valves can handle corrosives and slurries with equal ease. The positive slotted key drive in the ball eliminates ball wear and ball wobble, permits equal flow in either direction. You get the best features of a globe, gate and plug valve in every Fullport Compression-Mounted Ball Valve —at one low price. The Teflon seats, the extra deep stuffing box and the exclusive "V" ring packing which eliminates troublesome "O" rings are Fullport extras for extra valve service and extra long life. The stem packing, if it should ever be required, can be replaced while the valve is in operation.

Fullport Compression-Mounted Ball Valves are immediately available in stainless steel in sizes ½" through 6". They test to 1000 psi cold non shock service and 300 psi at 400° F. Through bolts for compression mounting are supplied with each of these valves.

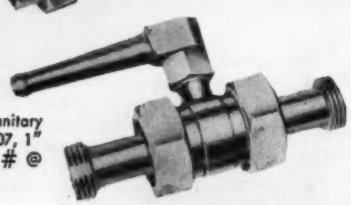
For more information about this and other Cooper Alloy corrosion resistant ball valves write for catalog #BVFA.



Fullport Stainless Steel Flanged Ball Valve, MSS and ASA face to face dimensions, #8002, ½" through 2", 150 PSI @ 400°F. service.



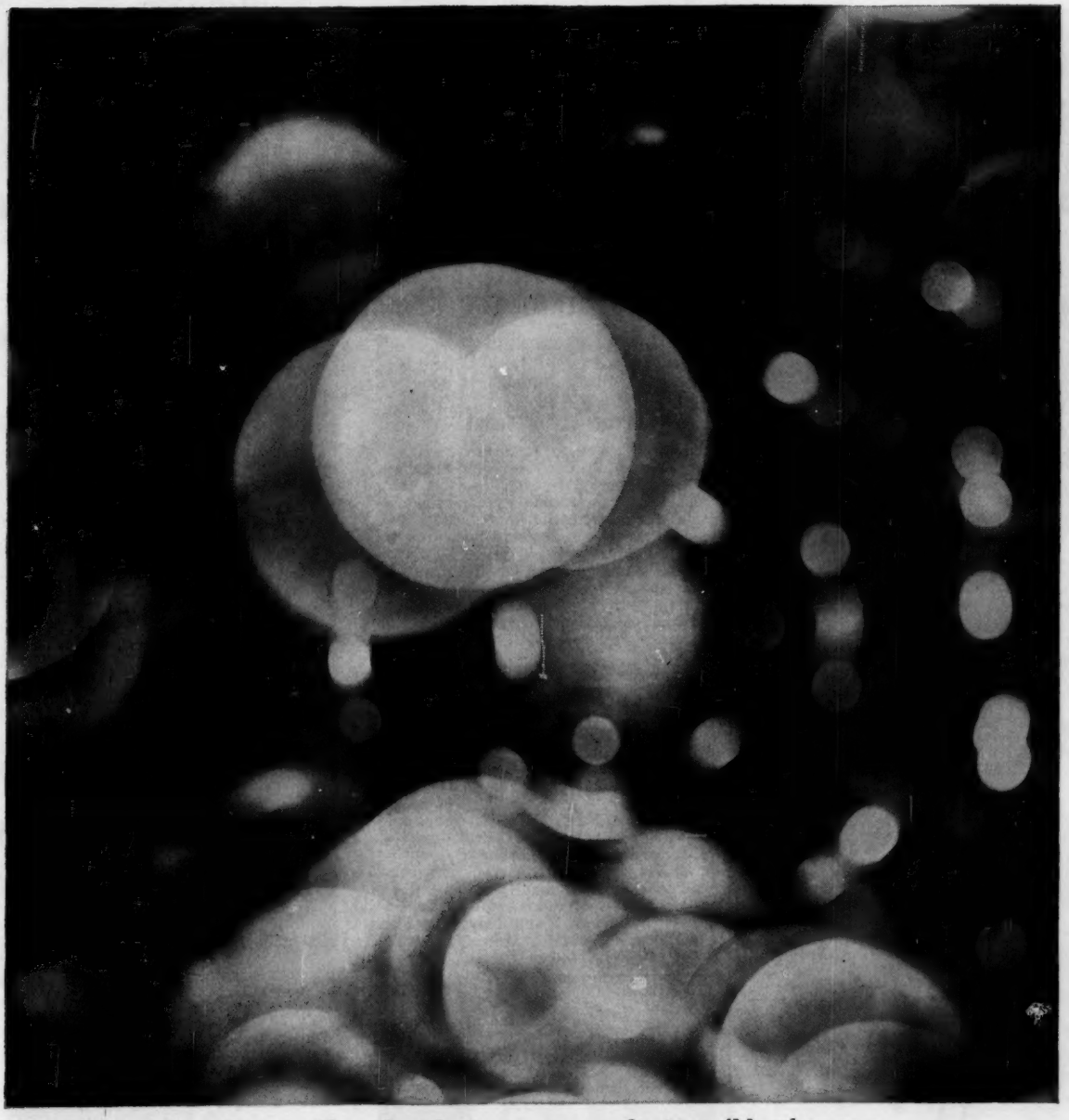
Fullport Stainless Steel Screwed Ends Ball Valve #8001, ½" through 2", 1000 PSI cold non shock 300 # @ 400°F. service.



Stainless Steel Sanitary Ball Valve #8207, 1" through 2", 150 # @ 400°F. service.

**COOPER ALLOY**

Corporation • Hillside, New Jersey



**Molecular magic makes an old product better, a new product possible when you**

# *mix imagination with Alcoa Aluminas*

Industrial magic—the magic of molecular action—has made ALCOA® Aluminas one of today's most rewarding product development materials. Ingredient, agent, reagent, catalyst or catalyst support, alumina in one of its varied types has sparked product and process development in industries ranging from ceramics to cosmetics, chemicals to paper, petroleum to rubber. The reason lies in the unique combination of physical, chemical, thermal and electrical properties which aluminas possess. And years of exploration have shown ALCOA the intriguing ways in which basic alumina molecules may be rearranged to provide crystal structures with the precise balance of properties needed by the individual user. Now it is possible to tailor the many types and grades of alumina to the exact needs of a specific product or process. Our White Data Sheets detail the properties of each grade and type of ALCOA Alumina available to speed your own product development activity. For a copy, write ALUMINUM COMPANY OF AMERICA, 706-L Alcoa Building, Pittsburgh 19, Pa.

**ALCOA CHEMICALS**

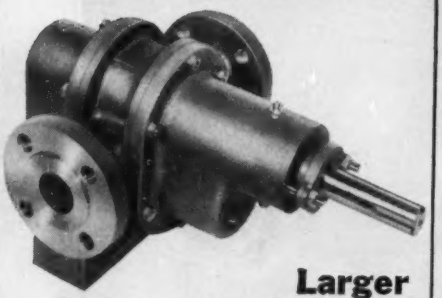
ALUMINUM COMPANY OF AMERICA

**For finer products . . . let Alcoa add new dimension to your creative thinking!**

# ECO ENGINEERING NEWS

*the big name in small pumps for the process industries*

## • New at ECO •



### Larger GEARCHEM Pumps

Eco GEARCHEM Pumps, formerly made only in ⅜ in. and ¾ in. port sizes for capacities up to 3 gpm. and 10 gpm. respectively, are now available in the new 900 Series with 1½ in. ports and comparable higher capacities, greatly enlarging its range of service applications.

Two models are available; either with threaded ports or with integrally cast 150 lb. A.S.M.E. flanges, as illustrated.




### SUBMERSED Pump

In such services as pumping out vessels under high vacuum, pumping high temperature materials, and pumping out of vacuum into atmosphere, this submersed GEARCHEM pumping unit eliminates problems of shaft seal leakage, heat-traced plumbing, low NPSH, etc.

## Eco Pumps Serve Producers of Rare Biochemicals Used to Study the Chemistry of Life Itself

Schwarz Biochemicals and Radiochemicals are known and used by medical and biochemical institutes throughout the free world.

### Products of Yeast

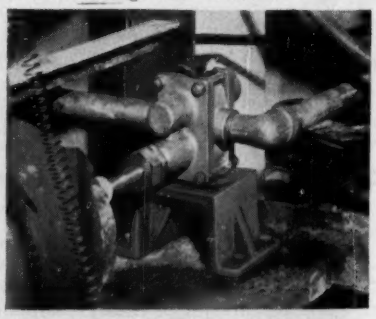
"About 20 years ago," states Mr. David R. Schwarz, President of Schwarz BioResearch, Inc., "we had the idea that biochemicals, produced by yeast, might be useful for investigation in biological and medical science, if we could learn how to extract and purify them economically. Our parent company, Schwarz Laboratories, Inc., with 80 years of experience as consultants to the brewing and food industry, furnished an ideal background for such a program.

### Stimulated by Biological Research

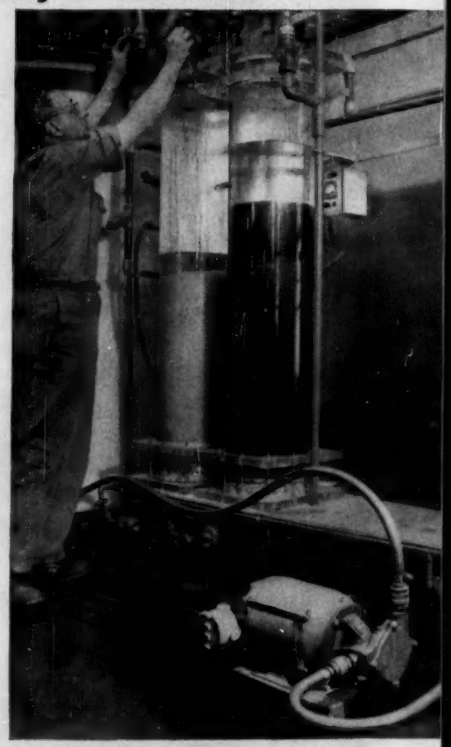
"The rapid expansion in biological research throughout the world greatly extended our original plans. Today the Schwarz price list includes 250 products extracted from natural sources or synthesized.

### New Frontiers of Medicine

"These included both deoxyribonucleic and ribonucleic acids and their derivatives, of which Schwarz are leading or exclusive producers, as well as tritium-bearing compounds which have made possible entirely new types of investigation into the chemistry of nucleic acids and living cells. It is this research of today that leads to tomorrow's new drugs and medicines."



Eco GEARCHEM Gear Pump of 316 stainless steel with Teflon gears and bearings meters brewing water alkalinity corrective into 5 gallon containers at neighboring plant of Schwarz Laboratories, Inc. Metering is controlled by pump revolution counter and accuracy is maintained within ± 1%.



Eco CENTRI-CHEM Centrifugal Pump on portable skid alternates between several duties. Here it is pumping deionized water at Schwarz BioResearch, Inc.

### Eco Pumps Serve Exacting Needs

Eco CENTRI-CHEM Centrifugal Pumps of Carpenter 20 stainless steel with Teflon and ceramic mechanical seals offer the ultimate in a chemically sterile, mechanically trouble-free pump. At Schwarz BioResearch, they are in such services as handling deionized water; pumping caustics (from the 3rd to the 5th floor of plant); recirculating slurries in scrubber of spray dryer, etc.

These CENTRI-CHEM pumps have been in service for periods of from 10 months to more than two years with negligible downtime for repairs.

### ECO Products for Handling Corrosive and Hazardous Processing Fluids

**ALL-CHEM® Rotary Pumps**
**MINILAB® Rotary Pumps**
**GEARCHEM® Gear Pumps**
**CENTRI-CHEM® Centrifugal Pumps**
**PUMPMOBILE® Portable Pumping Units**
**GEAR-VAC® Valves**
**CHEMICAL DISPENSING VALVES**
**Factory Mutual Approved**

*Ask for literature on any or all of these ECO Products*

**ECO ENGINEERING COMPANY · 12 New York Avenue · NEWARK 1, N.J.**



# BETTER, CLEANER, MORE WORKABLE STEELS

## through A-L Vacuum Melting Techniques



Microstructure of Ti-hardened A-286 showing Ti compound stringers in Air Melt (above) and absence of such stringers in Vacuum Melt (below).

### *What you can expect from A-L's Consutrode,® Invac, and Invacutrode steels and alloys.*

If you have really critical applications, you need A-L's Consutrode, Invac, and Invacutrode steels and alloys, products of unique vacuum melting operations. These alloys provide a combination of improved metallurgical and mechanical properties. They give you the ultimate in complex high-temperature missile and aircraft superalloys . . . provide the finest bearing steels, low alloy steels, stainless steels, tool steels . . . meet the most critical applications . . . withstand the worst service conditions.

Here are a few of the specific advantages you get in A-L's vacuum melted materials:

- √ Higher mechanical properties—fatigue strength, transverse ductility, toughness
- √ Improved cleanliness and decreased gas content
- √ Better hot and cold workability
- √ Higher Reliability—Extended Life
- √ Fewer Rejections—Decreased Part Cost

A-L's modern melting techniques can be applied to help solve your problems. And these vacuum melted steels are in regular production, available now in all commercial mill forms and sizes.

For further information on A-L's modern melting techniques and the advantages of Consutrode, Invac, and Invacutrode alloys, get the new booklet, "Modern Melting at Allegheny Ludlum." It's packed with engineering data. Ask your nearest A-L sales office for a copy, or write: ***Allegheny Ludlum Steel Corporation, Oliver Building, Pittsburgh 22, Pennsylvania. Address Dept. CE-11.***

**ALLEGHENY LUDLUM**

PIONEERING on the Horizons of Steel

2258

# Wrap up high temperature laboratory heating problems fast with new CAL-CORD*





Here's news from Glas-Col . . . a new, flexible cord developed especially for high temperature laboratory heating applications. It's easy to use . . . as flexible as an appliance cord . . . and delivers uniform temperatures. Cal-Cord comes complete with cord and plug. There are no troublesome loose terminals on the ends.

**TWO SIZES—400°C and 600°C**

**Medium "Cal-Cord"—400°C Specifications**

| Catalog No. | Length | Wattage | Price |
|---|---|---|---|
| C-C 2 | 2-ft. | 80W, 115V | $ 6.50 |
| C-C 3 | 3-ft. | 120W, 115V | 9.00 |
| C-C 4 | 4-ft. | 160W, 115V | 11.00 |
| C-C 6 | 6-ft. | 240W, 115V | 15.00 |

Made of glass fabric materials. Can be furnished for 220V operation.

**Super "Cal-Cord"—600°C Specifications**

| Catalog No. | Length | Wattage | Price |
|---|---|---|---|
| SC-C 2 | 2-ft. | 200W, 115V | $ 8.00 |
| SC-C 3 | 3-ft. | 300W, 115V | 13.75 |
| SC-C 5 | 5-ft. | 500W, 115V | 18.00 |

Made of quartz fabric materials. Can be furnished for 220V operation.



**CAL-CORD TEMPERATURE CONTROL**

This Thermolyne Stepless Type 800 temperature controller, recently developed, is ideally suited for use with "Cal-Cords." It's a 115V unit. Maximum amps: 13. Watts: 1500. Price $15.75.

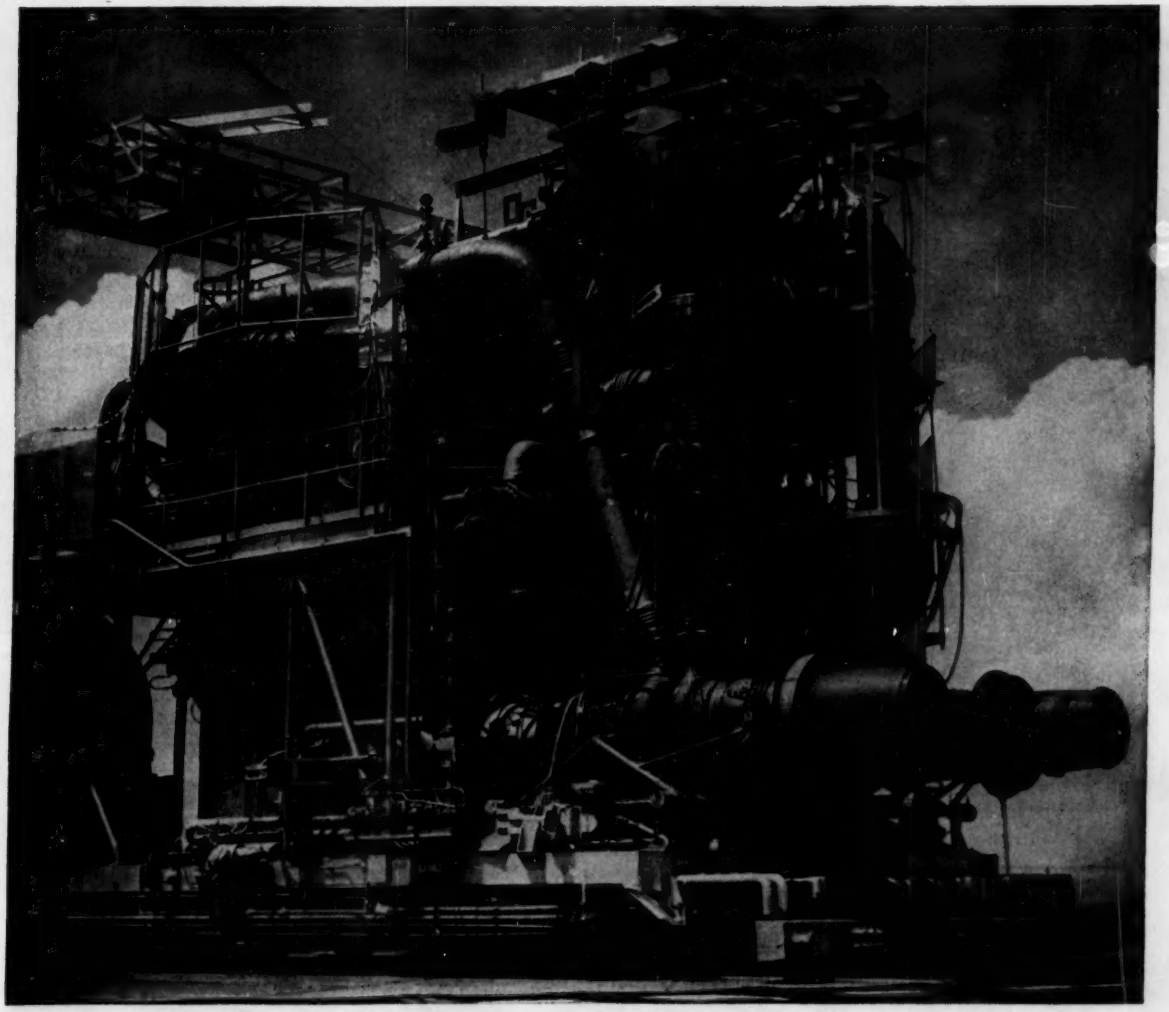
*Patent Pending

**Write for information on "Cal-Cord" today!**

**GLAS-COL** Cal-Cords

Dept. CR, 711 Hulman St. Terre Haute, Indiana

World's largest manufacturer of heating mantles for laboratory, pilot plant, and chemical process heating applications.



# Where expansion joint reliability really counts... YOU FIND ZALLEA

Eighteen Zallea Expansion Joints protect all the piping between compressor, reactor and turbine in General Electric's Heat Transfer Reactor Experiment (HTRE). Sizes range from 18-in. to 30-in. diam. Temperatures are 500 F and 1500 F at 53 psig.

Objectives of HTRE were to develop and test a complete aircraft nuclear power plant system, to determine operating characteristics, and to verify the design of a direct-air-cycle nuclear propulsion system. As in any research involving unknown quantities (in this case the heat source) a basic requirement for all system components was *maximum reliability*. The results of HTRE were successful. Objectives were accomplished. The integrity and life of all system components were verified.

This is another example of Zallea competence in the nuclear field. In fact, Zallea has provided the large majority of all the expansion joints used in atomic, nuclear and missile projects. Our work with almost every major engineering and manufacturing firm in these fields has given us an unequalled background of experience and engineering capacity. It can give you important savings in time and investigation when expansion is involved in piping systems or tanks.

Write for Catalog 56, which contains complete and comprehensive engineering data for Expansion Joints from 3-in. to 50-ft. diam., pressures to 3600 psi, temperatures to 1600 F.

ZALLEA BROTHERS, Taylor and Locust Streets, Wilmington 99, Delaware.

*Zallea* **FOR MAXIMUM RELIABILITY**

**WORLD'S LARGEST MANUFACTURERS OF EXPANSION JOINTS**

News from
National Carbon Company
Division of Union Carbide Corporation · 270 Park Avenue, New York 17, New York
In Canada: Union Carbide Canada Limited, Toronto

## National Carbon Design Engineers expand your engineering force



**J. L. MILLER**
**Design Engineer**

Mr. Miller graduated from Yale University with a B.S. in Chemical Engineering and joined National Carbon Company in 1948.

Since then, Mr. Miller has worked on applications of carbon, graphite and "Karbate" impervious graphite materials in corrosive services both in the field and in the laboratory. He has been particularly active in application engineering and development of graphite anodes for impressed current cathodic protection.

### SAVINGS ON MAINTENANCE COSTS

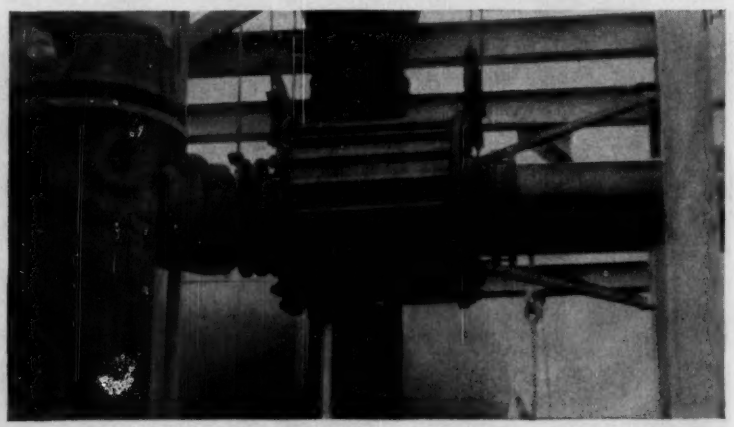
Two typical reports show trouble-free service with "Karbate" impervious graphite pumps in chemically cleaning equipment.

A petroleum company using a Type F centrifugal pump on its portable equipment cleaning rig reports, "We are very pleased with the performance of this equipment and would not hesitate to recommend its use to others for cleaning operations."

A chemical equipment cleaning company uses Type F centrifugal pumps for transferring muriatic acid from tank cars to storage tanks and from these tanks to trucks. "Karbate" impervious graphite pumps were installed here after attempts to move the acid by other methods were unsatisfactory. Maintenance on other corrosion-resistance lined pumps proved too costly. Twelve "Karbate" impervious graphite pumps, one to each station, are handling this operation with virtually no maintenance.

# "KARBATE" EQUIPMENT USERS REALIZE MANY SAVINGS!

**Users of "Karbate" Impervious Graphite Equipment Report Savings in Recovered Product . . . on Long Equipment Life . . . and on Maintenance Free Operations.**

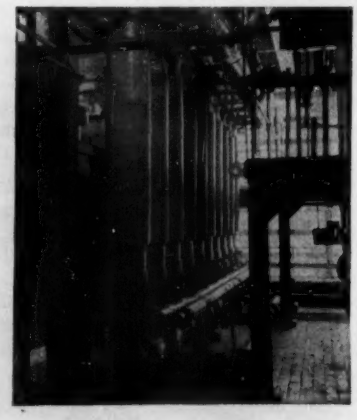


A 20" "Karbate" Impervious Graphite Entrainment Separator in an Acid Vapor Line.

### SAVINGS IN RECOVERED PRODUCT

After installing a 20" "Karbate" impervious graphite Type MV entrainment separator on a spin bath evaporator, a major rayon producer recovered chemicals valued at approximately $2800 a year. These savings paid the equipment cost in roughly a year.

Based on the proved efficiency and savings in this installation, this company has purchased eleven additional units for use throughout its operations.



### SAVINGS ON LONG EQUIPMENT LIFE

In 1951, a large pharmaceutical producer installed 10 "Karbate" Series 240A shell and tube heat exchangers to cool an organic slurry containing HCl. These exchangers have been in service for nine years, and are operating today with minimum maintenance.

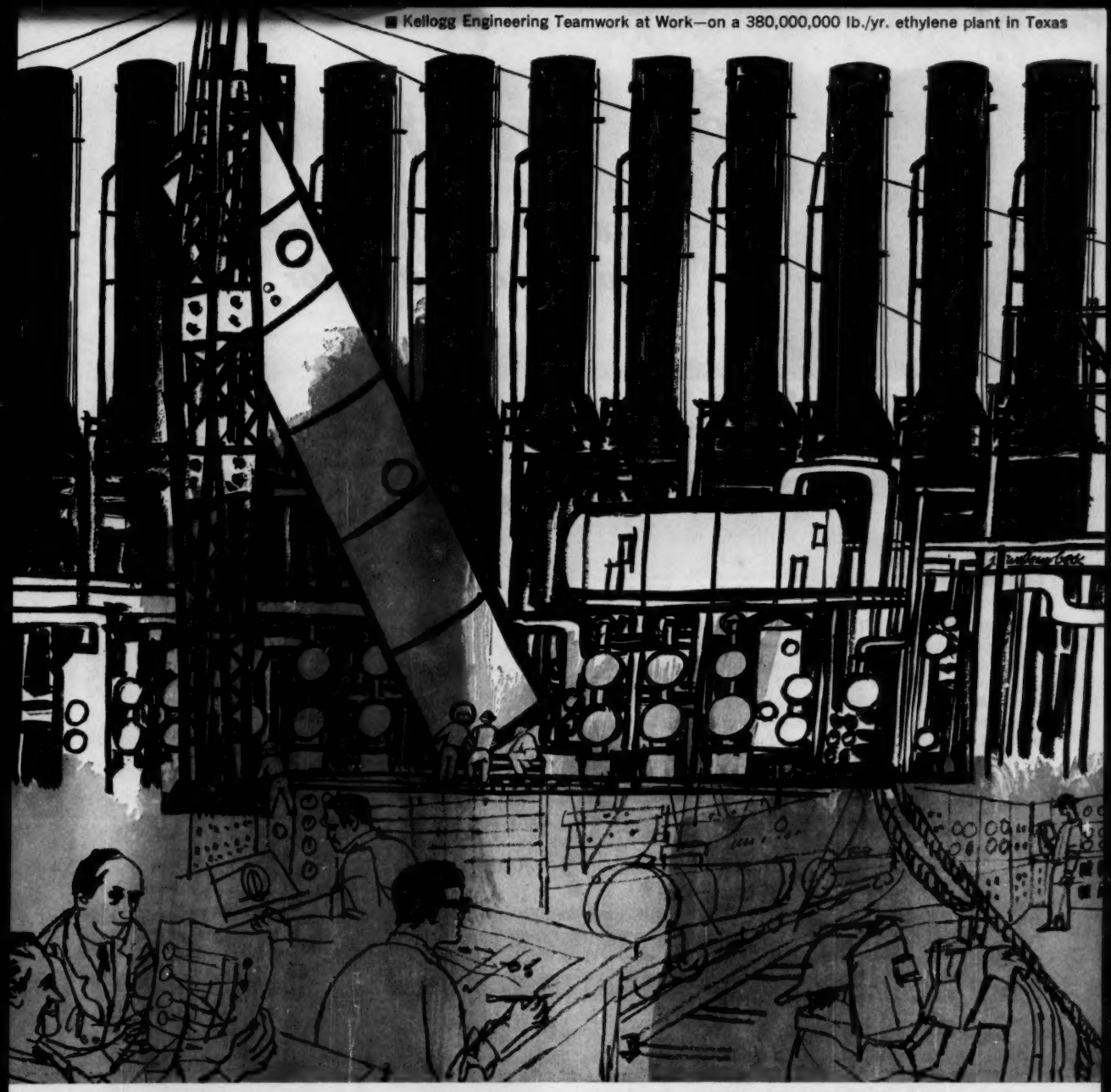
Each exchanger has twenty-four 7½′ long tubes, ⅞" I.D. x 1¼" O.D. and operates as a single pass unit.

10 "Karbate" Series 240A Heat Exchangers cool an organic slurry containing HCl.

"National", "Union Carbide", "N" and Shield Device and "Karbate" are registered trade-marks for products of

**NATIONAL CARBON COMPANY**

UNION CARBIDE



■ Kellogg Engineering Teamwork at Work—on a 380,000,000 lb./yr. ethylene plant in Texas

## CHEMICAL PLANTS FROM SCRATCH

For many of the world's leading chemical and petrochemical firms, the Kellogg method of executing a capital investment in new plants and plant expansions has proved the soundest way to minimize expenditure.

This economic route to new chemical plants consists of coordinating and controlling all phases of engineering, procurement, and construction under an internationally integrated management. It is founded on close teamwork among all Kellogg operations at home and abroad . . . and with client engineering staffs.

Kellogg's method has improved process and plant engineering . . . saved money in procuring materials and equipment . . . increased labor productivity . . . expedited erection . . . achieved the earliest possible on-stream dates . . . and stayed within predetermined costs. The result is the plant which achieves the optimum balance of investment and operating costs.

Working with clients on this basis, Kellogg has been responsible for a variety of chemical plants throughout the world. In the United States, current projects include: a 380,000,000 lb./yr. ethylene plant in Texas; an 18,000,000 lb./yr. epichlorohydrin plant in New Jersey; a 300 ton/day ammonia plant in Missouri; a 200 ton/day urea plant in Delaware.

---

If you are planning to build new processing facilities in the U.S. or overseas, Kellogg would be glad to show you how its engineering teamwork could work to your company's advantage. Please address inquiries to The M. W. Kellogg Company, 711 Third Avenue, New York 17, N.Y.

**THE M. W. KELLOGG COMPANY** / A Subsidiary of Pullman Incorporated

Offices of other Kellogg companies are in Toronto, London, Paris, Rio de Janeiro, Caracas, Buenos Aires

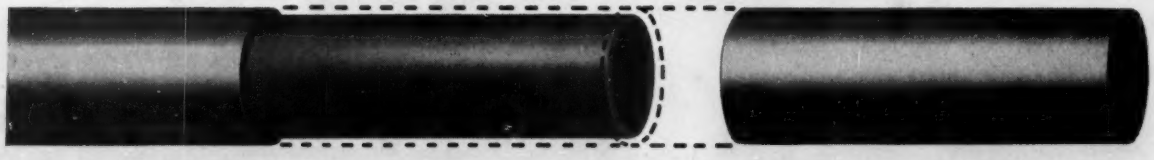
M KELLOGG W



# Call Carpenter*

**or your nearest authorized Carpenter distributor**

## ...*for BI-METALLIC TUBING

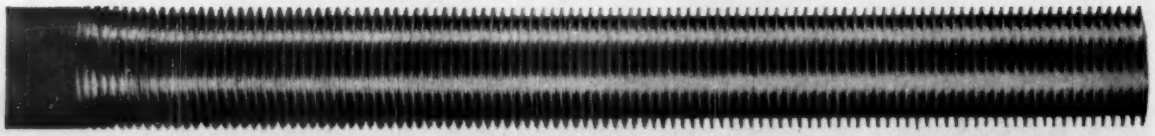


Carpenter Bi-Metallic Tubing is the single answer to dual corrosion problems in heat exchangers and condensers. Simultaneously it provides effective resistance to two different types of corrosive attack on tubing O.D. and I.D. surfaces. It is ideally suited for retubing existing heat exchangers, condensers and other heat transfer equipment where tubing of a single material throughout will not satisfactorily meet dissimilar corrosive conditions on the shell and tube sides.

It consists of full-finished stainless tubing mechanically bonded to the entire I.D. or O.D. surface of carbon, brass, copper, stainless or other alloy tubing to form a single unified tubular structure. A full range of heat exchanger sizes, gauges and lengths is available. Tube ends can be fitted with ferrules of the same metal as the inside tube for installation in tube sheets. Ask for Bulletin BMT.

## ...*for INTEGRAL-FINNED TUBING

*Stainless and High Alloy Analyses*



Carpenter-Manufactured Integral-Finned Tubing offers significant operating and design advantages for heat transfer equipment operated in corrosive service conditions. It is a practical and economical means of increasing the effective capacities of existing plain-tube units. An appreciable reduction in the overall size of new heat transfer units is possible with Carpenter Integral-Finned Tubing, with resultant savings in materials and space.

Approximately 2½ times greater external heat transfer area than plain tubing is obtained with Carpenter Integral-Finned Tubing. It is equally suitable for straight-tube and U-tube bundles, coils and other tubular arrangements needed for heating or cooling functions.

Produced from plain-surface full-finished stainless steel tubing of heat exchanger quality, Carpenter Integral-Finned Tubing has 16 fins per inch of length with standard height of 0.0575″. Diameter of finned portion is 0″ to 0.025″ less than the diameter of the unfinned portions. Continuous or spaced finned sections can be supplied.

Lengths up to 25 feet are available in sizes, gauges and analyses generally required for heat transfer equipment. Send for Bulletin IFT.

Call nearest Carpenter office or distributor for quotations and delivery on Bi-Metallic and Integral-Finned Tubing, and for technical help with their application to fit your needs.

The Carpenter Steel Company, Alloy Tube Division, Union, N.J.

*your master key to cost-saving corrosion control*




**Stainless Tubing & Pipe**

# YARWAY news briefs

*from* **Yarnall-Waring Company,** *Philadelphia 18, Pa.*

*BRANCH OFFICES IN 19 UNITED STATES CITIES • SALES REPRESENTATIVES THROUGHOUT THE WORLD • STEAM TRAPS STOCKED AND SOLD BY 270 LOCAL INDUSTRIAL DISTRIBUTORS*



## THIS STEAM TRAP WILL DISCHARGE 25,500 LBS. OF CONDENSATE PER HOUR

This is a typical installation of a Yarway Series 40 Impulse Steam Trap—a trap designed specifically to gobble up extra heavy condensate loads.

The trap is a No. 48, 2½" size, and is installed on a suction heater connected with an 86,000 barrel tank containing fuel oil at a storage terminal. The operating pressure is 13 psi. At this pressure the trap has a capacity of 25,500 lbs. continuous discharge of condensate per hour.

At operating pressure of 100 psi, the trap's capacity is 62,000 lbs. per hour.

### CAPACITY—PLUS

Capacity isn't the whole story on Yarway Series 40 Steam Traps. Like all Yarway Impulse Traps, they offer advantages like quick heat-up, even temperatures, small size, good for all pressures, non-freezing.

Series 40 traps also feature high temperature discharge characteristics, excellent low pressure operation, no airbinding, operation against back pressures up to 40%, and stainless steel construction.

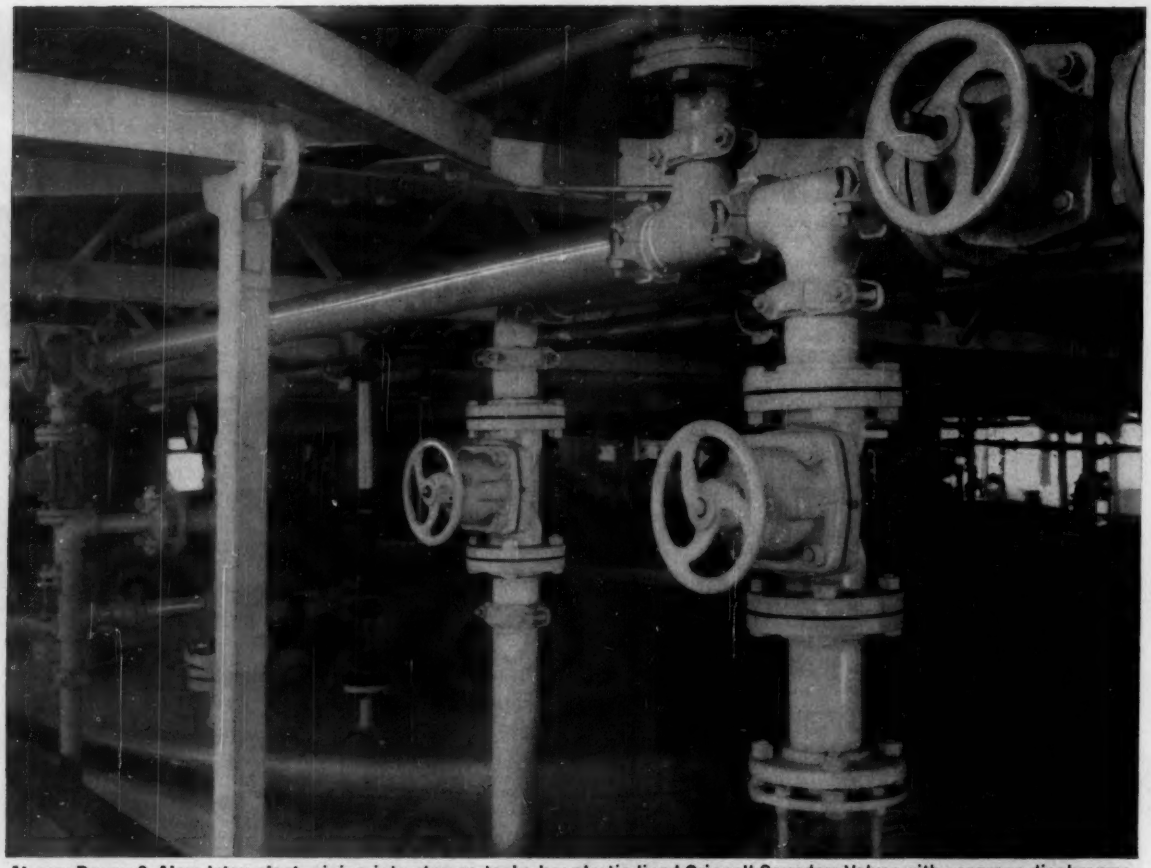
You can get Yarway's latest steam trap Bulletin T-1743, or arrange for a free 60-day trial of a Yarway Impulse Trap, by writing to Yarnall-Waring Company or contacting your local Industrial Distributor.




*Yarway ½" No. 40 Impulse Steam Trap (shown actual size). Also available in ¾", 1½", 2" and 2½" sizes.*

YARWAY OFFERS IMPULSE STEAM TRAPS FOR THESE SPECIFIC OPERATING CONDITIONS

| AVERAGE CONDENSATE LOADS | EXTRA HEAVY CONDENSATE LOADS | LIGHT CONDENSATE LOADS |
|---|---|---|
|  |  |  |
| Series 60 | Series 40 | No. 30 |



**At new Dewey & Almy latex plant,** piping into storage tanks has plastic-lined Grinnell-Saunders Valves with neoprene diaphragms.

At Dewey & Almy plant...

# Grinnell-Saunders Diaphragm Valves guard against plugging, corrosion, contamination

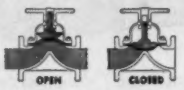
The new Owensboro, Kentucky plant of Dewey and Almy Chemical Division, W. R. Grace & Co., makes polyvinyl acetate emulsions and butadiene-styrene co-polymers for adhesives, paper coatings, emulsion paints and other products.

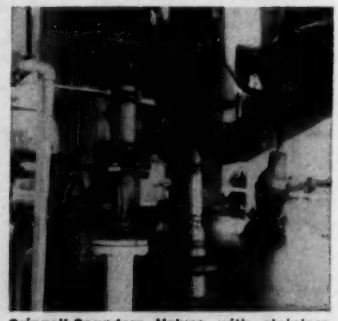
These co-polymers present several manufacturing problems: build-up of obstructions that plug lines, high viscosity that needs wide-open lines, easy hardening by the air.

Selected to handle this tough job: *Grinnell-Saunders Diaphragm Valves.* These rugged valves have a diaphragm that lifts high for streamline flow; seals tight for positive closure. Bonnet mechanism is completely isolated from material in the line by the diaphragm to prevent corrosion and contamination.

What's more, Grinnell-Saunders Diaphragm Valves give smooth passage of material . . . eliminate trapping of solids, reduce frictional resistance. You can choose from a number of body, lining and diaphragm materials.

Find out how Grinnell-Saunders Diaphragm Valves can help *your* installation. Write Grinnell Company, Providence 1, R. I.



**Grinnell-Saunders Valves** with stainless steel bodies and teflon diaphragms were specified for the reflex lines of this co-polymer reactor.

## GRINNELL-SAUNDERS DIAPHRAGM VALVES

GRINNELL COMPANY, PROVIDENCE 1, R. I. • BRANCH WAREHOUSES AND DISTRIBUTORS FROM COAST TO COAST
PIPE FITTINGS • VALVES • PIPE HANGERS • PREFABRICATED PIPING • UNIT HEATERS • PIPING SPECIALTIES

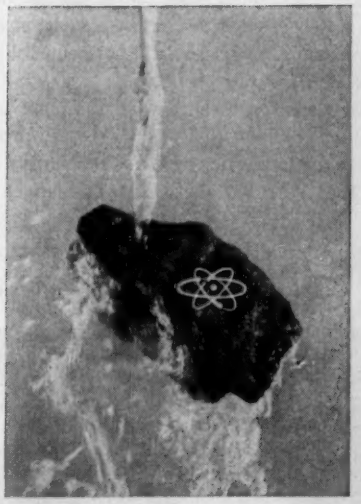
# BRIEFS

**oxalic acid**
**phosphoric anhydride**
**chlorine chemistry**



## WE GET FAN MAIL

Manufacturers are more likely to get complaints than compliments and, in most companies, are set up to handle them as delicately and expeditiously as possible. But no one seems to have a setup for the routine handling of complimentary letters. So, when customers write in to compliment us on the uniformity of particle size and quality of our oxalic acid, all we can do is be pleased about it. This at least affords an opportunity to stress the point that we take a lot of pains to keep sulfates low (to a typical 150 to 300 ppm). We make oxalic acid in two crystal sizes, numbers 2 and 3 fine, and as non-dusting as possible. It assays at 99.8% min. Ask for Data Sheet No. 789, covering properties and uses of oxalic acid.

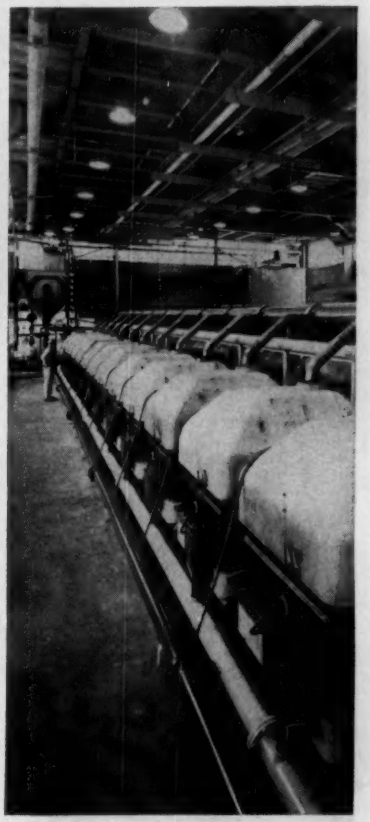


## $P_2O_5$ INVADES THE WORLD OF THE ATOM

There's a relatively new process being used to recover uranium oxide from crude ores. It substitutes solvent extraction for the older phosphate precipitation method and not only gets more uranium from the ore but does it more cheaply, permitting more automation, too. The solvent employed is dodecyl phosphoric acid made from Hooker phosphoric anhydride (pentoxide). Advantages for the new process include low first cost for solvent, re-use of solvent, low solubility of solvent in aqueous phase, high concentration ratio, low over-all chemical costs. Hooker $P_2O_5$ assays typically 98% minimum. Contaminants such as Fe, Pb and Cl are maintained at a 2 ppm max. Fluorine is no greater than 3 ppm. Arsenic is no higher than 50 ppm, and sulfate is completely absent. Write for Data Sheet No. 802.

## BECAUSE WE'RE MAJOR CHLORINE PRODUCERS

We've learned a great deal about handling and using chlorine in the fifty-seven years we've been making it. A great deal of chlorine is used in our captive processes for such things as chlorobenzenes, chlorotoluene compounds and similar products. But we sell much more than we use ourselves, which is one reason why we publish safety charts and technical manuals and go to great lengths to help customers use chlorine safely as well as effectively. When you get right down to it, almost anything worth knowing about the handling and uses of chlorine can be learned from Hooker. We can ship from several points in cylinders, ton containers, or railway tank cars. Try us and see how well we can serve you.



**For more information,** check here and mail with name, title and company address:

- ☐ Oxalic acid data sheet
- ☐ Phosphoric anhydride data sheet
- ☐ Chlorine manual

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HOOKER CHEMICALS PLASTICS

# Modern Aloyco casting operations pay off for customers!

As the world's leading specialist in the manufacture of Stainless Steel Valves, Aloyco constantly seeks new techniques, new equipment and new ideas for improving product uniformity and quality. Close integration between sales, engineering, foundry and all phases of manufacturing result in better control of quality, prompt deliveries, and more flexible customer service.

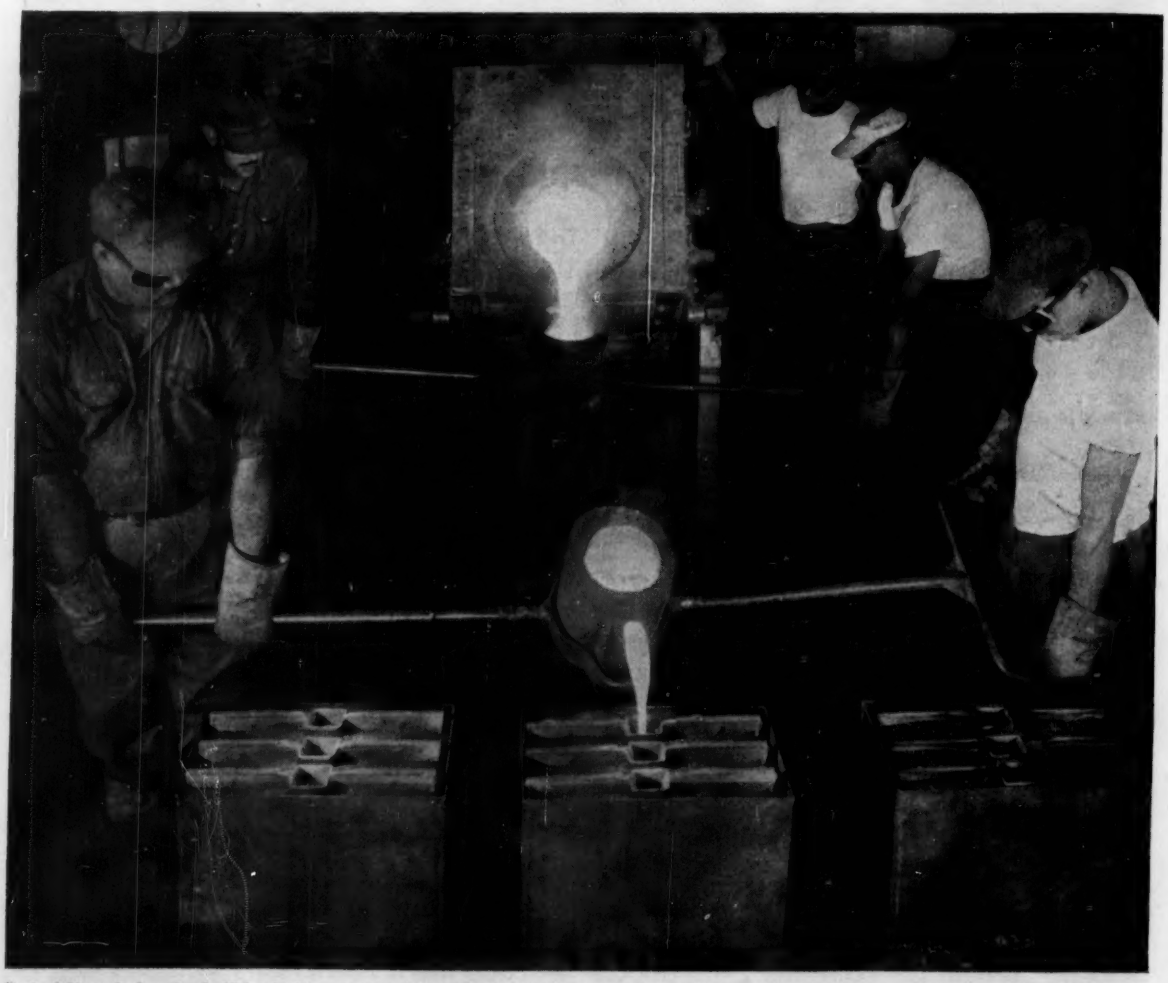
Aloyco combines over 30 years of specialized experience with the most advanced equipment for putting that experience to work on your corrosion problems. Technically qualified Aloyco men are available throughout the country to help you. Alloy Steel Products Co., Inc., 1301 West Elizabeth Ave., Linden, N.J.



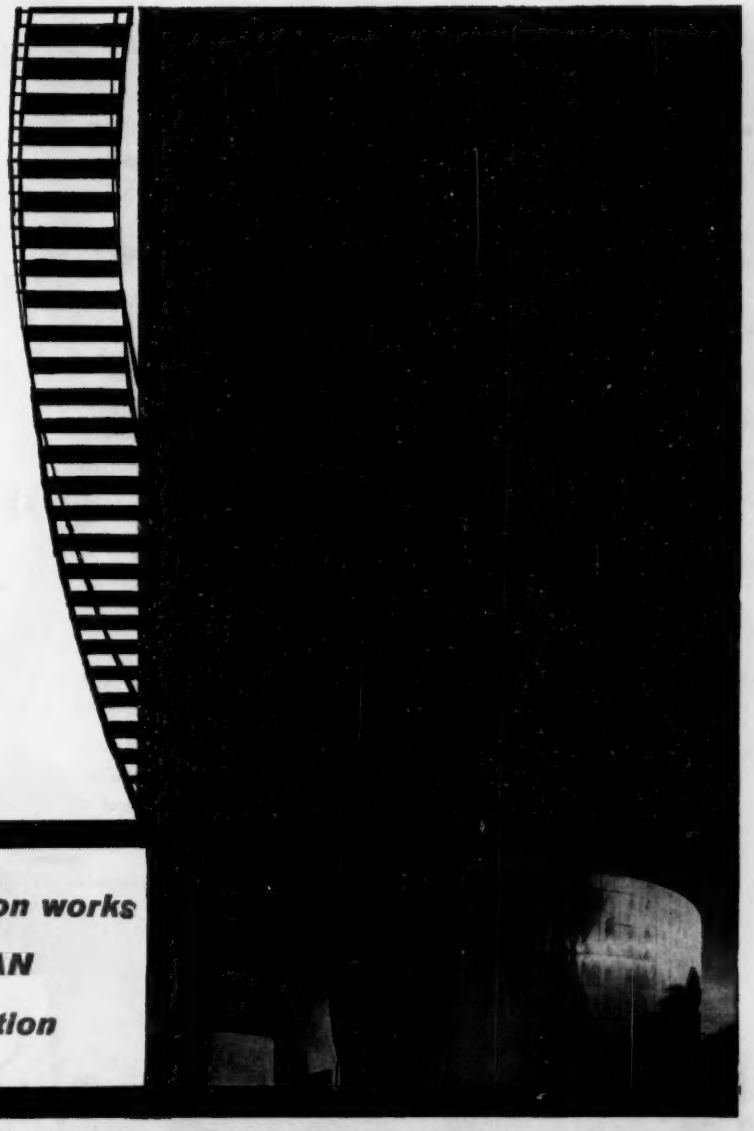

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ALLOY STEEL PRODUCTS COMPANY

Boston • New York • Wilmington • Atlanta • Birmingham • Baton Rouge • Buffalo • Pittsburgh • Chicago • St. Louis • San Francisco • Los Angeles • Seattle



**Part of Aloyco's foundry facilities** include modern shell moulding techniques which permit unusually high dimensional accuracy. Radiographic inspection and dye penetrant testing are part of a comprehensive and rigid control program that assures castings of highest quality and uniformity.



## *FOAMGLAS® Insulation works for GENERAL AMERICAN Transportation Corporation*

**EVIDENCE:** In 1955, the world's two largest styrene storage tanks were constructed on the Houston Ship Canal at Pasadena, Texas, by the Tank Storage Terminals Division of General American Transportation. A constant 50 to 60°F inside the tanks is required to prevent the loss of the styrene through solidification. Despite the heat and humidity of the Gulf Coast, a two-inch jacket of FOAMGLAS Insulation has proven an accurate temperature control.

FOAMGLAS is impervious to moisture, thus maintains constant insulating value. The insulation jacket eliminates tank corrosion. Even an acid atmosphere from neighboring chemical storage tanks doesn't penetrate FOAMGLAS. And FOAMGLAS is incombustible—another benefit important to General American.

The choice of FOAMGLAS insulation for these huge tanks was no accident. General American has used it successfully on caustic soda tanks in New Jersey, on steam lines in Chicago and in other applications at Pasadena. They knew the low-cost, easy installation and long-life features of FOAMGLAS.

Write for free copies of the General American Fact Sheet and our new Industrial Insulation Catalog: Pittsburgh Corning Corporation, Department H-110, One Gateway Center, Pittsburgh 22, Pa. In Canada: 3333 Cavendish Blvd., Montreal, Quebec.

**Pittsburgh Corning has a complete line of accessories for use with FOAMGLAS. Write for Data Sheets.**

**PITTSBURGH PC CORNING**

# Only
# TURBULAIRE-DOYLE
# SCRUBBERS

## GIVE YOU JET-ACTION GAS-CLEANING WITH NO MOVING PARTS!

**The Turbulaire-Doyle Scrubber is unique** in its high collection efficiencies and low maintenance requirements because it incorporates a jet-action design that assures a far more thorough scrubbing action—yet requires no complex mechanical systems that boost maintenance and repair costs.



### THE JET-CONE MAKES THE DIFFERENCE!

This Jet-Cone in the throat of each Turbulaire-Doyle inlet tube causes a sharp increase in the velocity of the incoming gases—the velocity reaching maximum at the point where the dirt-laden gases impinge upon the scrubbing liquid.

RESULT: ***unusually deep penetration of gases into the scrubbing fluid for more complete cleansing of all suspended particles—even those in the fume range.***

Yet there are no moving parts—nothing to require frequent repair or replacement!



ILLUSTRATED ABOVE: **Two-stage rubber-covered units remove dust and fume from gases at wet process phosphoric acid plant. Capacity: 64,000 CFM.**

## Compare
### TURBULAIRE-DOYLE ADVANTAGES

- **HIGH COLLECTION EFFICIENCIES** generally in the 97% to 99% range.
- **FINE PARTICLE COLLECTION** even fume-range particles.
- **LOW LIQUID-TO-GAS RATIO** only 1 to 5 GPM/1000 CFM.
- **NEGLIGIBLE MAINTENANCE** no moving parts to wear or corrode—no "plugging" problems.
- **NO CORROSION PROBLEMS** simple design permits wide choice of corrosion-resisting materials.

*Send for Descriptive Bulletin!*

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# RED HOT PROBLEM-SOLVER




There are three basic reasons why this brand has been stamped on so many successful projects recently.

**REASON NO. 1**—Platinum Metals have a superior *combination of properties* . . . resistance to high temperatures, exceptional corrosion resistance, catalytic action.

**REASON NO. 2**—Platinum Metals *perform* and continue to serve—often where no other materials can endure.

**REASON NO. 3**—Platinum Metals are *cheaper* than you think, because of their high recovery rate.

We make Platinum Metals in all shapes and forms . . . sheet, strip, foil, wire, tubing, gauze, salts and chemicals. And we operate complete *catalyst* and *scrap recovery* units. Clads and composites also available in many forms.

Bulletin No. P-6 tells our story. Write for it.

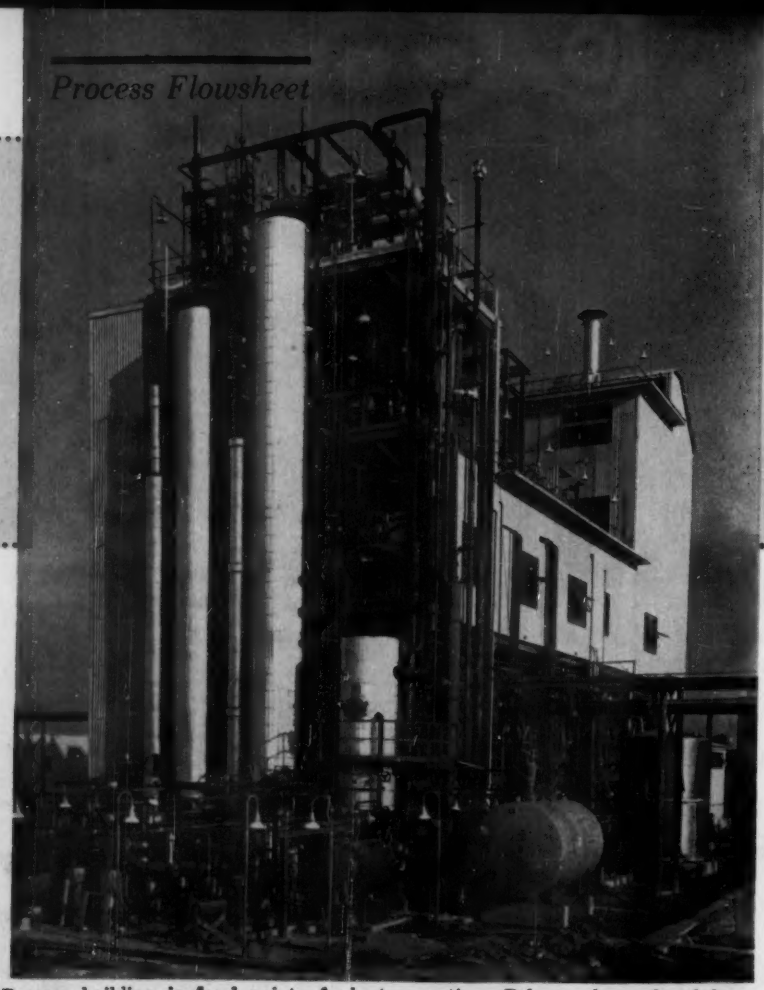
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A JOHNSON MATTHEY ASSOCIATE PHONE: NIAGARA 4-3100

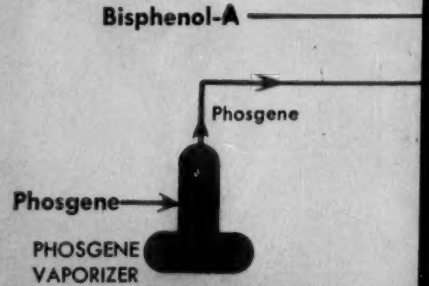
"METALS FOR PRECISION AND PERFORMANCE"

*Process Flowsheet*



**Process building is focal point of plant operation. Polymer is produced here, finished in nearby building. Towers in foreground recover pyridine, solvents.**

**Polycarbonate Production**




N. P. CHOPEY
*Assistant Editor*

$$(CH_3)_2C(C_6H_4OH)_2 + COCl_2 \longrightarrow HCl + \left[OC_6H_4C(CH_3)_2C_6H_4OC(=O)\right]$$

Bisphenol-A — Phosgene — Polycarbonate unit

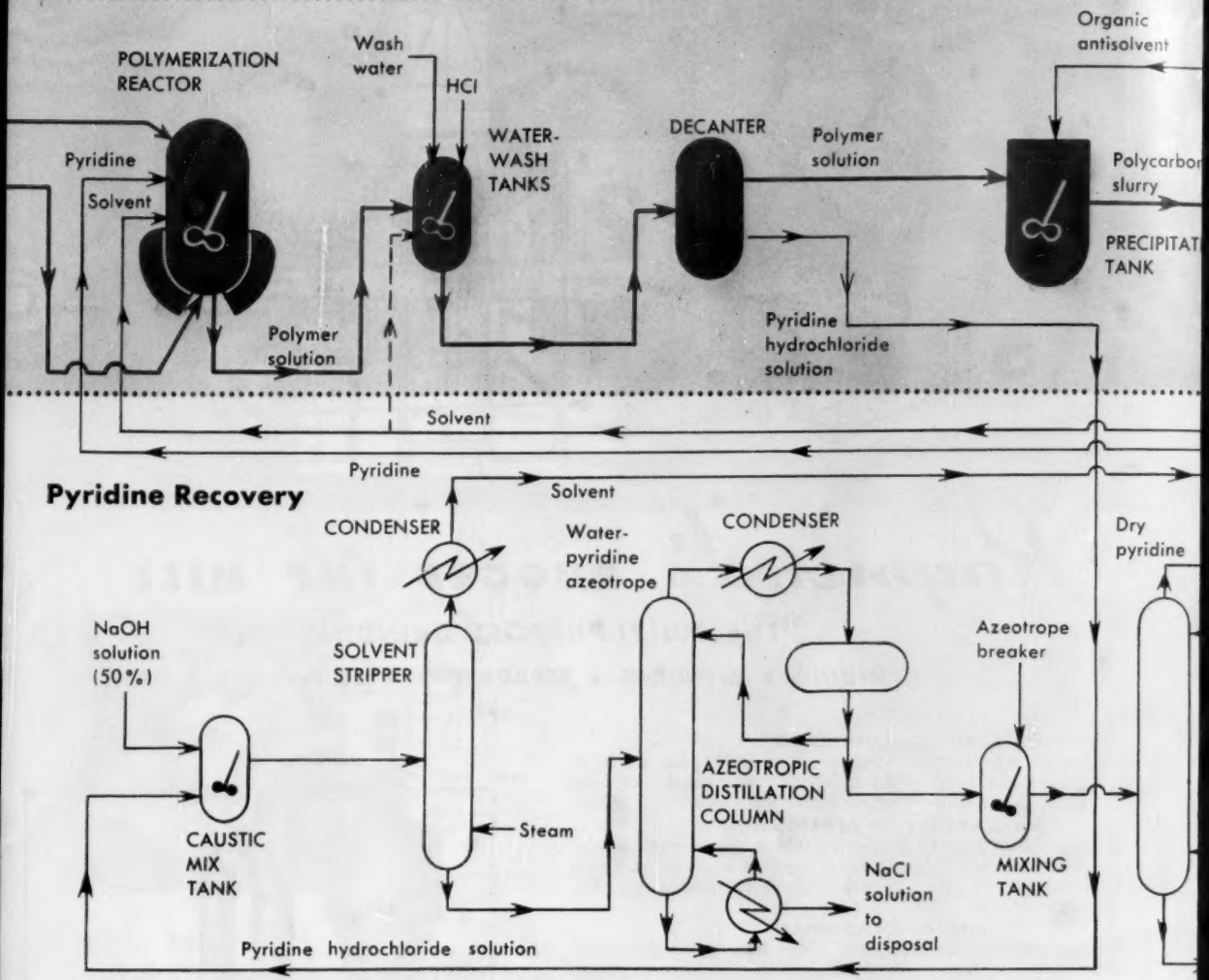
**Unfold Flowsheet**

# Making Polycarbonates: A First Look

***General Electric Co. takes most of the wraps off its new polycarbonate resins plant in this exclusive report on commercial production of the promising newcomer plastics.***

Polycarbonate resins took another big step toward established commercial status in the plastics field a few weeks ago, when General Electric Co. made the first full-scale production run of the promising new resins at its recently completed Mt. Vernon, Ind., plant. Climaxing an outlay of $11 million for research, development and facilities, the installation is geared to make 5 million lb./yr. of these carbonate-linked polymers—and is capable of quick expansion to much higher levels as demand rises.

GE's plant startup is among the latest in a series of news items about the resins, dating back to an announcement around 1957 that GE and the German firm, Farbenfabriken Bayer, had independently come up with commercially promising polycarbonate developments. The two firms executed a cross-licensing agreement on anticipated U.S. patents and proceeded separately




toward commercialization of the new polymers.

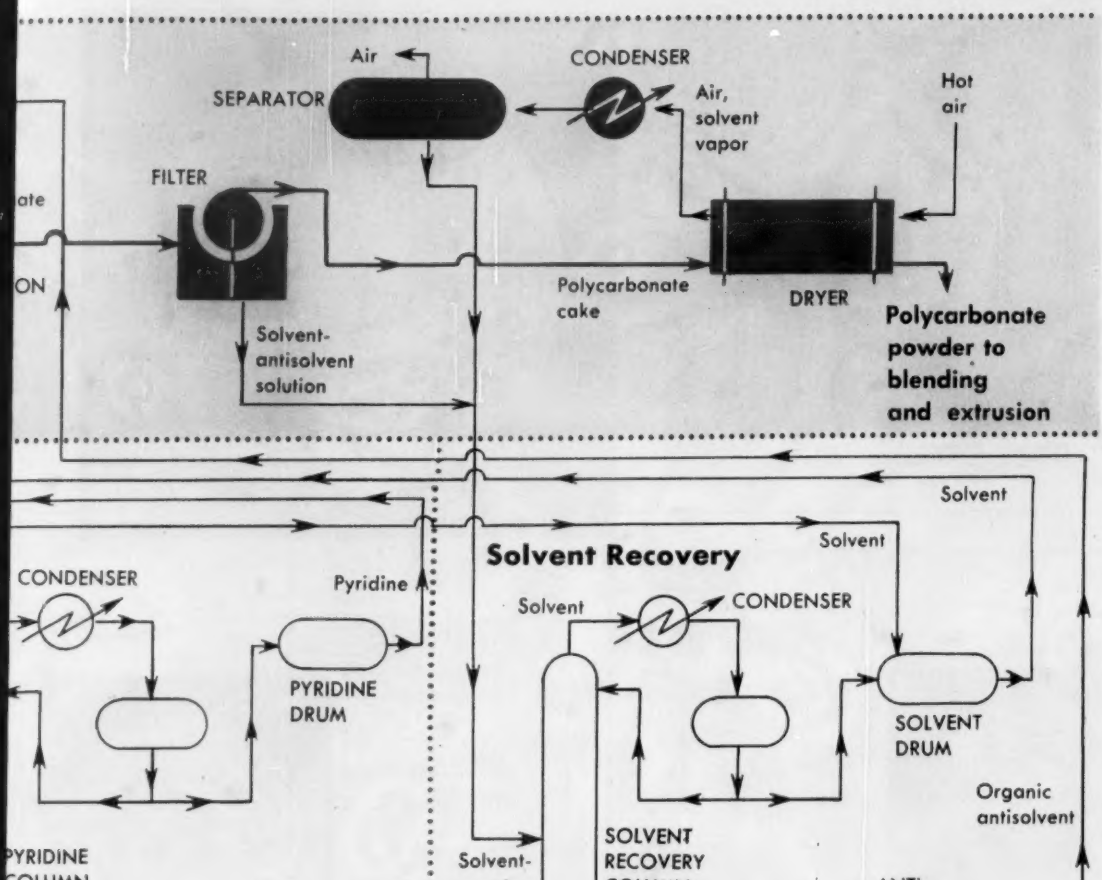
Both reached fully commercial status in the U.S. this summer—GE at Mt. Vernon, and Bayer through its American subsidiary, Mobay Chemical Co., which went on stream with a polycarbonates unit of undisclosed capacity in June at New Martinsville, W. Va.

GE and Mobay are the only firms commercially producing polycarbonates in the U.S. today. But, plastics observers say that virtually every large company in the polymers field is interested. The interest seems amply justified, because GE predicts a U.S. polycarbonates demand of 30-50 million lb./yr. by 1965, and 75-100 million lb./yr. by 1970.

▶**What They Are**—Why all the excitment about polycarbonates? First, they represent a new polymer structure, being the first thermoplastic resins in which the linking elements are carbonate radicals (see formula, in box). And, in addition to boasting a long list of desirable properties they can be fabricated by just about all techniques used in plastics technology today.

Outstanding properties that GE cites for its polycarbonates, which are marketed under the Lexan tradename, include high impact strength, good heat resistance, exceptional dimensional stability and good electrical properties. Too, the resins are transparent, boast low water absorption, are noncorrosive, nontoxic, stain-resistant and self-extinguishing. They exhibit strength over a wide temperature range: —60 to 270 F.

These and other features indicate a bright future for polycarbonates, in applications that can make good use of the resins' qualities. Working with semicommercial-scale production from its




lities at Pittsfield, Mass., GE has already come with some 300 uses during market development, ging from dentures to tank-turret ball bear-. Included are applications for business hines, appliances, electronics and communica-s equipment, aircraft and military items, and y other use areas. The polycarbonates promise eplace metals in some applications.

**own the Road**—All this is just a beginning, GE kesmen believe as they look toward the future. y point out the many substitution positions ilable on the monomer's molecular formula, and ision the current resin as just the basis for an ntual large family of products. And although t present applications involve molded pieces, company sees product forms such as films, tomers, fluids and maybe even fibers as likely he long-range polycarbonates picture.

GE looks optimistically on the factor of costs, as well. Current polycarbonate price per pound is around $1.50; the company hopes to work this figure down to $0.90-1.20 by 1962, and to $0.60-0.85 by 1965 if the expected market develops.

▶ **How They're Made**—Two basic routes have been mentioned in chemical literature for polycarbonate synthesis: ester exchange between a carbonate diester and a dihydroxy aromatic compound, or phosgenation of a dihydroxy aromatic. GE uses the latter at Mt. Vernon, makes resin by reacting bisphenol-A with phosgene in a system that also contains pyridine and an undisclosed solvent (see reaction, in box). Pyridine permits removal of byproduct hydrochloric acid; the solvent serves as carrier to maintain the process stream a fluid.

The Mt. Vernon plant was designed and engineered by Crawford & Russell, Inc., Stamford, Conn.

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Finished

nn. Its over-all operation includes the poly-erization reaction, removal of hydrochloric acid pyridine hydrochloride, separation of the resin d treatment of the pyridine and process solvents r reuse. The resin is finished for sale by blending th coloring agents, followed by extrusion and lletizing. Molecular weight of the product is out 18,000, and the pellets are available in 14 lors.

GE developed its process at Pittsfield, but corporated a few undisclosed modifications in aling the operation up for use at Mt. Vernon. incipal ones involve the separation of pyridine drochloride and subsequently the polymer from e main process stream. Too, the company won't veal some of the processing agents it uses, such the solvent mentioned above.

**Polymerize**—Bisphenol-A is weighed out and fed an agitated, jacketed polymerization vessel, gether with pyridine and solvent. Phosgene is porized in a still, then bubbled through the action mixture. GE currently buys the phosgene uses at Mt. Vernon, plans to begin producing it site early next year.

Phosgene and bisphenol react to form the lycarbonate monomer, which in turn polymer-s. Reacting mixture is kept under 104 F.; sidence time in the vessel is 1-3 hr. Reaction can controlled through any of several variables, cluding residence time, temperature and propor-ns of the components introduced. Component rity also has great effect on the reaction.

Reacted mixture, consisting of the polymer, ridine hydrochloride and unreacted pyridine in vent, is fed through polyethylene pipe to water-sh tanks. Wash water and hydrochloric acid are ded here, the acid reacting with residual pyri-ne. More solvent may also be introduced at this age, to lower the viscosity of the mixture.

**Purify**—Next step is removal of water and pyri-ne hydrochloride. GE won't disclose the equip-ment used for this purpose at Mt. Vernon, but reveals that decantation was used at Pittsfield. Aqueous phase goes to pyridine recovery; solvent phase, containing the dissolved polymer, goes to an agitated precipitation tank.

Here the polymer is dropped out by addition of an organic "antisolvent" that forms a solution with the carrier solvent but causes the polymer to precipitate. Precipitation occurs almost instantaneously.

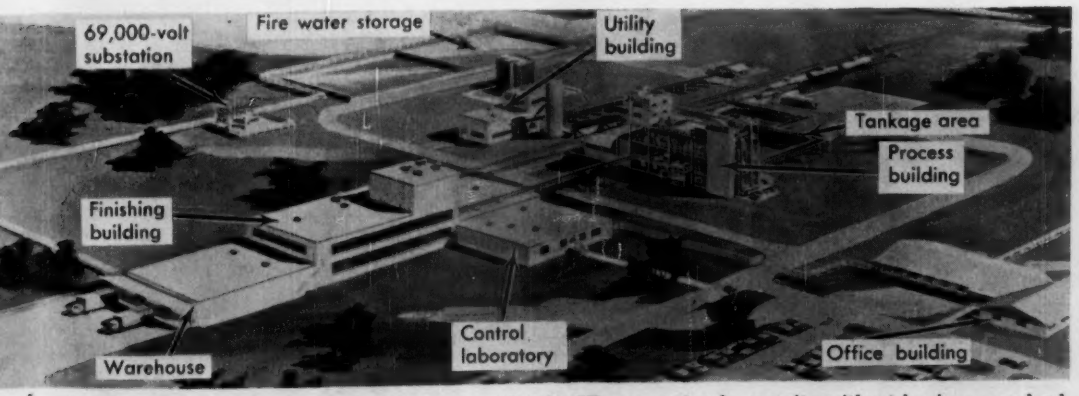
Resulting slurry goes to another separation step. GE experimented with several types of equipment for this separation at Pittsfield, including the rotary filter shown above. Separated polymer goes to a dryer, where hot air removes remaining solvent. Polymer leaves the dryer as a powder, is sent to a nearby building for blending, extrusion and pelletizing.

▶ **Recovery Systems**—Aqueous pyridine hydrochloride solution, removed before polymer precipitation, is combined with caustic solution in a mix tank, thus permitting removal of chloride ions as sodium chloride. First, however, the stream goes from the mix tank to a column where steam strips out any solvent present.

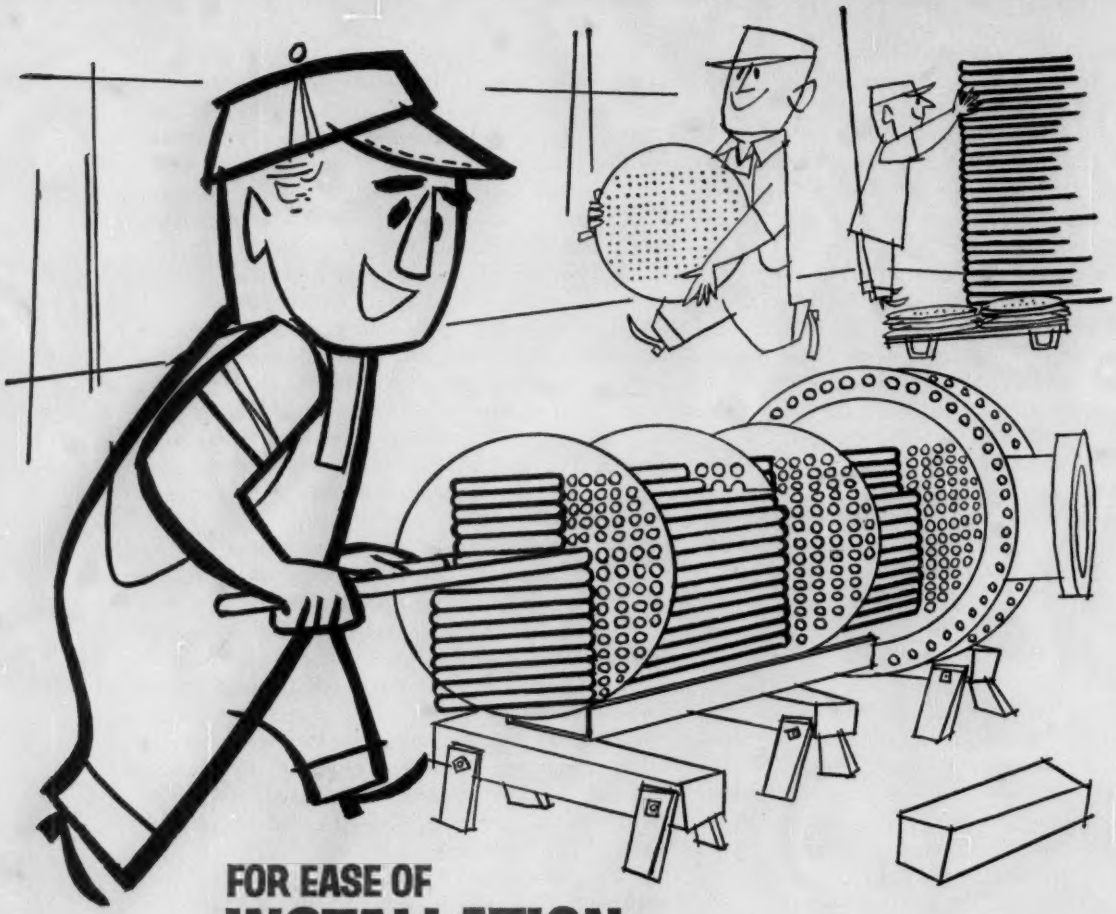
Stripped solution goes to an azeotropic-distillation column. Sodium chloride solution is removed as bottoms and discarded. Overhead stream is an azeotrope consisting of about 43% water, 57% pyridine.

The azeotrope is condensed, then combined with an undisclosed breaking agent. Mixture goes to a pyridine distillation column where water-free pyridine is removed overhead. Bottoms are treated to recover the breaking agent.

Recovery of the carrier solvent and the antisolvent, which are removed as a mixture after polymer precipitation, is a straightforward process. Mixture goes to a distillation column; solvent leaves overhead and the antisolvent is recovered as bottoms.




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- a welded tube with a new concept of quality, designed specifically for economical long life in heat exchangers

B&W Job-Matched LECTROSONIC Heat Exchanger Tubing is available through a nationwide network of district sales offices and Steel Service Centers. And remember—matching tubes to jobs assures you the *right tube,* in the *right quantity,* at the *right time.* For more information, call your local B&W District Sales Office, or write for Bulletin T-431. The Babcock & Wilcox Company, Tubular Products Division, Beaver Falls, Pennsylvania.

Steel

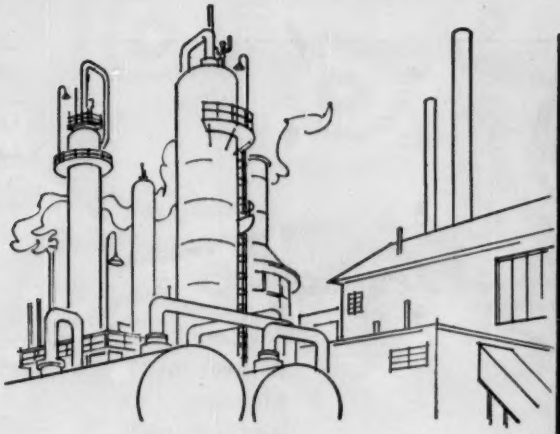
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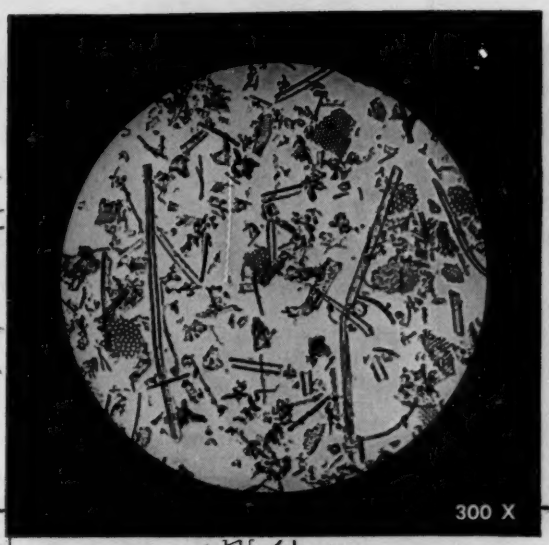
THE BABCOCK & WILCOX COMPANY

***TUBULAR PRODUCTS DIVISION***

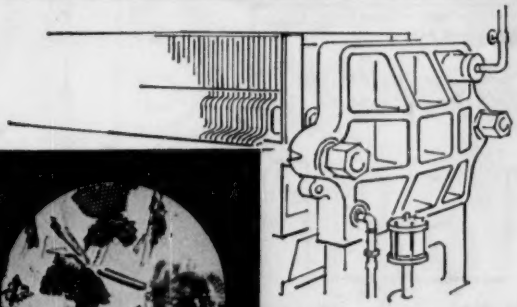
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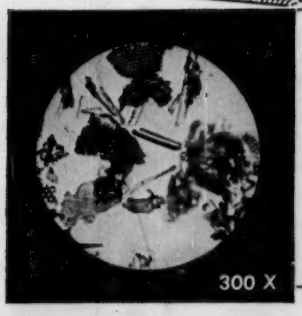
Seamless and welded tubular products, solid extrusions, seamless welding fittings and forged steel flanges—in carbon, alloy and stainless steels and special metals



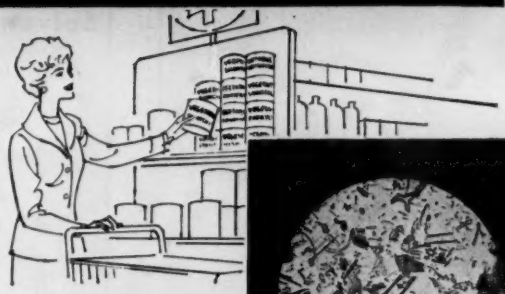


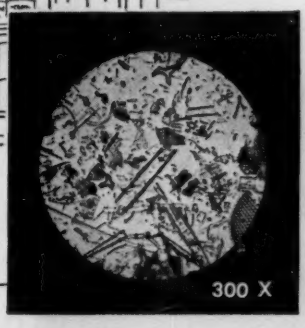

**For flow rate plus clarity**—Hyflo Super-Cel has the right combination of large and fine particles. Heavily used in chemical processes such as caustic soda production.






**For fast flow rates**—Celite 545 has a higher proportion of coarse particles. Frequently used for clarification of resins and other viscous liquids.






**For maximum clarity**—Filter-Cel has a relatively fine particle size distribution. Used in producing lard, salad oil, other hydrogenated oil products.

***In diatomites, Johns-Manville precision processing works for you***

# Celite has the exact grade for every filtration need from fast flow rate to maximum clarity

Study samples of various filtration grades of Celite* diatomite with the unaided eye. Rub them between your fingers. One grade looks, feels very much like another.

Then compare these grades under the microscope. Each has its own distinctive particle size distribution. Each is precision-milled to fill the most exacting filtration requirements, ranging all the way from maximum flow rate to maximum clarity.

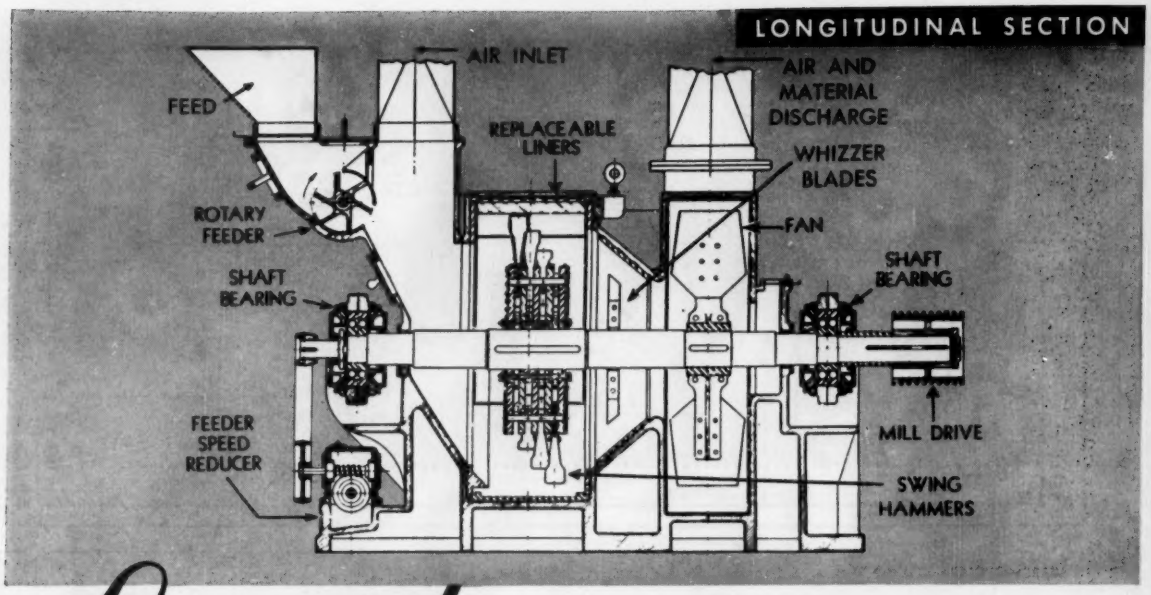
*Celite 545*, for example, with a higher proportion of large to fine particles, is used to remove large suspended impurities at maximum flow rates. *Hyflo Super-Cel®* has a balanced particle size distribution, combines good liquid clarity and moderate flow rate. But *Filter-Cel®* has a much higher ratio of small particles, is tailored for use where high clarity outweighs flow rate.

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**JOHNS-MANVILLE**




# *Raymond's* RUGGED IMP MILL

## THE MULTI-PURPOSE GRINDING UNIT

**GRINDING • BLENDING • SEPARATING • CONVEYING • DRYING**

**⚹ DESIGNED FOR FINE GRINDING**

The Imp Mill is particularly intended for medium fine and fine grinding of softer non-metallic minerals and many manufactured products. Wide usage of the Imp Mill is made in a great many fields where pulverizing is desired.

**⚹ VERSATILITY OF APPLICATION**

Mills are built in a variety of types and sizes to produce many different capacity requirements. They have a wide degree of adjustment of product fineness, ranging from about 20 mesh to 325 mesh, depending upon material handled.

**⚹ NEED OF CLASSIFIER**

For higher finenesses or more uniform finished products than the Imp Mill would normally produce, an air classifier may be used. Either an integral Whizzer Separator or a Raymond Mechanical Air Separator could be installed according to the particular type of operation needed and the material to be processed.

**⚹ FLASH DRYING**

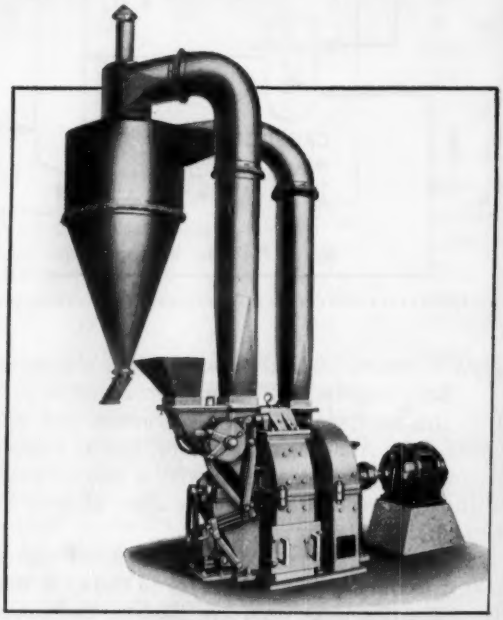
The basic design of the Imp Mill readily adapts itself to the simultaneous drying and pulverizing of materials. The Mill utilizes heated air or products of combustion for removing surface moisture and, in special cases, chemically combined water from materials during grinding. In all instances air is used as the conveying medium.

**⚹ FLEXIBLE IN INSTALLATION**

Each Mill System is a compact installation, engineered to fit most any plan or layout. The floor space is held to minimum requirements of Mill and Drive Motor. Piping variations permit cyclone collector, within limits, to discharge material where needed. Systems are completely enclosed from feed hopper to finish bin.

**⚹ DUSTLESS OPERATION**

The excess air is diverted to a secondary collector or, where permissible, can be exhausted to the atmosphere.



FOR FURTHER DETAILS ON THIS AUTOMATIC UNIT WRITE FOR RAYMOND IMP MILL CATALOG NUMBER 87E

# COMBUSTION ENGINEERING, INC.

*Raymond Division*

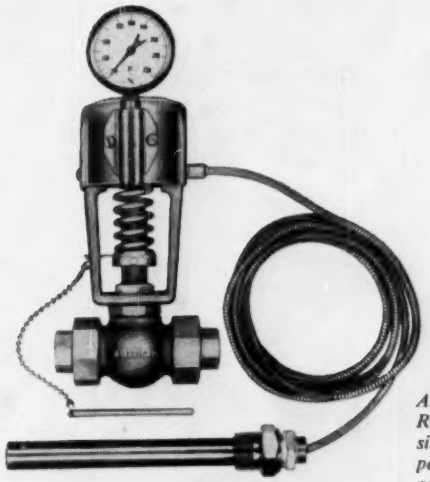
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# response

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There are other high-quality features in American Temperature Regulators: maximum use of stainless steel; standardized parts; the fewest possible components; and unitized assembly. In addition, compactness simplifies installation in "tight" locations.

Accurate temperature regulation and attention-free operation mean long-term economy. Your industrial supply distributor will gladly help you select the right American Temperature Regulators for your needs. Write for Bulletin 114A.

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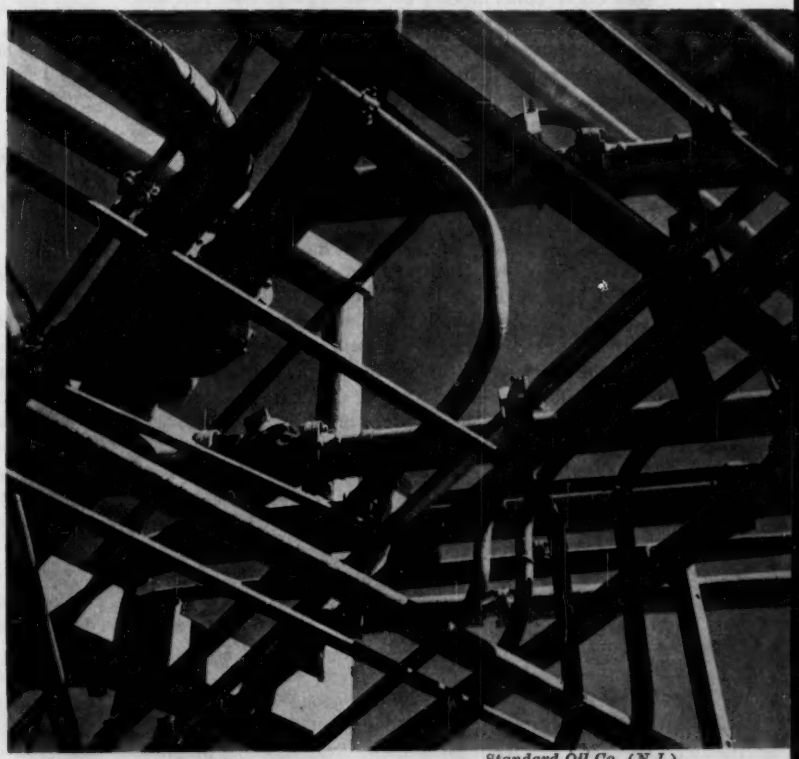
FORGED STEEL
VALVES

1 PROCESS PIPING

2 DIRECTORY OF MANUFACTURERS

3 INVENTORY OF LITERATURE

As chemical plants turn to more severe operating conditions to boost yields and throughputs, process piping takes on added importance. More resistant, more expensive materials must be used, but choosing the "best" material calls for careful analysis of corrosion resistance, first and installation costs, and maintenance.



*Standard Oil Co. (N.J.)*

# Selecting Materials for Process Piping

C. K. ALDRICH,
*Consulting Engineer,*
*Buttzville, N. J.*

1 One of the most costly and difficult problems in the chemical process industries centers around the movement of highly corrosive liquids through piping systems.

In many plants, the trend is to higher temperatures and flowrates to increase efficiencies and yields.

This trend forces chemical engineers to search for more dependable, more corrosion-resistant materials of construction for process-piping systems, since all these severe conditions intensify corrosive action. Fortunately, a broad range of metallic and nonmetallic materials is now available for corrosive service. This is a definite improvement over the situation that existed a relatively short time ago, when choice was limited to a few alloys and glass- or rubber-lined pipe. But this surfeit of materials complicates the

job of choosing the "best" material, since in many cases a number of alloys and plastics will have sufficient corrosion resistance for a particular application. Final choice cannot be based simply on picking an alloy out of a corrosion table—it must be based on a sound economic analysis of competing materials.

In the discussion that follows, we distinguish between process piping and service piping (water, brine, waste-disposal lines). The emphasis here is on process piping. Also, since the majority of operating conditions in chemical plants involves temperatures of 75-500 F., we will limit ourselves to this range, as well as to moderate pressures. High- and low-temperature materials have been adequately covered.[1, 2, 3]

One other point cannot be overemphasized: full use should be made of the technical services offered by various manufacturers of piping materials, alloy products, plastics, etc. Through their wide experience with a great variety of products, these people are often qualified to make the best educated guess, particularly when new problems arise with materials.

**Recommended operating conditions—Table I**

**Based on 2 in, sch. 40 pipe and standard 150-lb. flanges and valves)**

| Material | Maximum Operating Temp., °F | Maximum Operating Pressure, Psig. At 75 F | Maximum Operating Pressure, Psig. At Max Op. Temp. |
|---|---|---|---|
| Aluminum | 400 | 150 | 150 |
| Carbon steel | 650 | 150 | 150 |
| Type 304 stainless | 1,500 | 150 | 150 |
| Type 316 stainless | 1,600 | 150 | 150 |
| Copper | 400 | 150 | 150 |
| Glass | 450 | 50 | 50 |
| Karbate | 340 | 75 | 75 |
| Epoxy glass | 220–300 | 150 | 150 |
| Polyester glass | 275 | 150 | 120 |
| Phenolic asbestos (Haveg 41) | 265 | 150 | 105 |
| Hard rubber | 225 | 50 | 50 |
| Polyethylene (high den.) | 160 | 75 | 25 |
| ABS (Type II) | 180 | 100 | 25 |
| PVC (Type I) | 170 | 150 | 55 |
| Saran | 150 | 125 | 50 |
| CAB | 140 | 100 | 50 |
| Saran lined | 200 | 150 | 150 |
| Rubber lined | 200 | 150 | 150 |
| Teflon lined | 500 | 150 | 150 |
| Glass lined | 500 | 150 | 150 |

## Ferrous Materials Most Popular

Carbon- and low-alloy-steel pipe have useful applications in many solutions in the neutral to high-pH range, where moderate corrosion and product contamination can be tolerated. Except in cases where effective inhibitors are present, pH should not fall below 4.5.

In acid exposure, steel can handle concentrated solutions at ambient temperatures. Much steel piping is used for transferring sulfuric or sulfuric-nitric acid containing not more than 30% $H_2O$.

Where the total acid concentration is less than about 95%, lines should be adequately vented during idle periods. In sealed lines, hydrogen pressure can build up to a dangerous level. Serious injury to operating personnel has resulted from blown gaskets.

## Stainless No Panacea

Of the metals and alloys that are useful in resisting severe corrosive conditions, the various grades of stainless steel probably find wider application than all others combined. For this reason, the first impulse of many engineers when confronted with a severe corrosive condition or an early failure of low-alloy steel is to specify an 18-8 stainless steel, particularly Type 304 or 316. Whether or not the specification is made depends on the experience of the particular engineer with stainless steel in environments that he considers to be similar, on experience reported by others that seems to provide evidence of reliability, reference to various corrosion tables and guides, or just a deep-seated idea that if steel won't work, stainless is bound to.

A better understanding of the nature of stainless should serve as a brake to its indiscriminate use. This does not mean that the chemical or design engineer has to take a course in metallurgy but merely that he recognize the basic limitations of the material.

When chromium is added to steel in small amounts, its corrosion resistance is not appreciably enhanced and in certain environments it is even lowered. Not until the chromium content reaches about 12% does the alloy exhibit passivity, due to a protective-oxide film—a film so thin that it is quite invisible and is detectable only by highly refined techniques. Corrosion resistance then is based on the ability of the material to maintain this film when a supply of oxygen is present rather than to any inherent resistance of the alloy itself. Since stainless steels contain precipitated phases (as opposed to solid-solution alloys) they are subject to local corrosion when the oxide film is destroyed (as by a lack of oxygen, or penetration by certain ions such as halogens.) Under these conditions, corrosion often proceeds more rapidly than with steel equipment.

Generally, stainless steels are passive under oxidizing conditions and active under reducing conditions. However, in chemical process streams it is frequently impossible to predict whether a given environment is oxidizing or not. And oxidizing or reducing capacity is also important, since attack is not a go or no-go situation. Properly designed and executed laboratory and plant tests are necessary before any decision is reached as to if, and what, stainless will work.

## Inhibitors Affect Stainless Resistance

Frequently, the direct use of service data obtained in an apparently related process, without adequate tests, can be disastrous. What is often overlooked is the presence of minor constituents that act as inhibitors or passivators. If they are present in one situation and not in another, transposition of corrosion data will, to say the least, lead to expensive failures.

Certain organic materials in concentrations of a few tenths of a percent completely inhibit corrosion of

stainless steel in hydrochloric or weak sulfuric acid. Heavy metal ions also act as effective passivators in sulfuric-acid solutions. In a 3% sulfuric-acid solution containing cobalt and nickel, Type 316 stainless is satisfactory above the atmospheric boiling point.

Without such inhibitors, 316 stainless is good for sulfuric at most temperatures below the boiling point, up to about 5%. Inhibitors can boost the permissible temperature at each concentration by about 60 F.

Type 304 stainless is not nearly as resistant to sulfuric, and can only be used with very dilute sulfuric below 100 F. Inhibitors improve 304 resistance.

Stainless steel finds wide use in handling nitric acid at all concentrations to 70% and temperatures to boiling. Grades that do not contain molybdenum are preferable for this service (Type 304).

Stainless steel is also widely used in the production of acetic acid and phosphoric acid. For these acids, the Mo-containing alloys (Type 316) are preferable. When product contamination must be kept at a minimum, stainless steel is widely used to convey organic materials and solutions of various salts (excluding halogens) that might otherwise be handled economically by low-alloy steels.

Where welding is involved, the low-carbon stainless steels or the stabilized materials should be considered to avoid any intergranular stress-corrosion problems.

In general, velocity conditions that insure a constant supply of oxygen to the metal surface are beneficial. Stagnant conditions such as exist in crevices or idle equipment should be avoided. On the other hand, high velocities can remove the oxide film. Probably a safe limit is 15 ft./sec.

On outside insulated lines, protect the insulation so rain does not leach chlorides and cause stress corrosion.

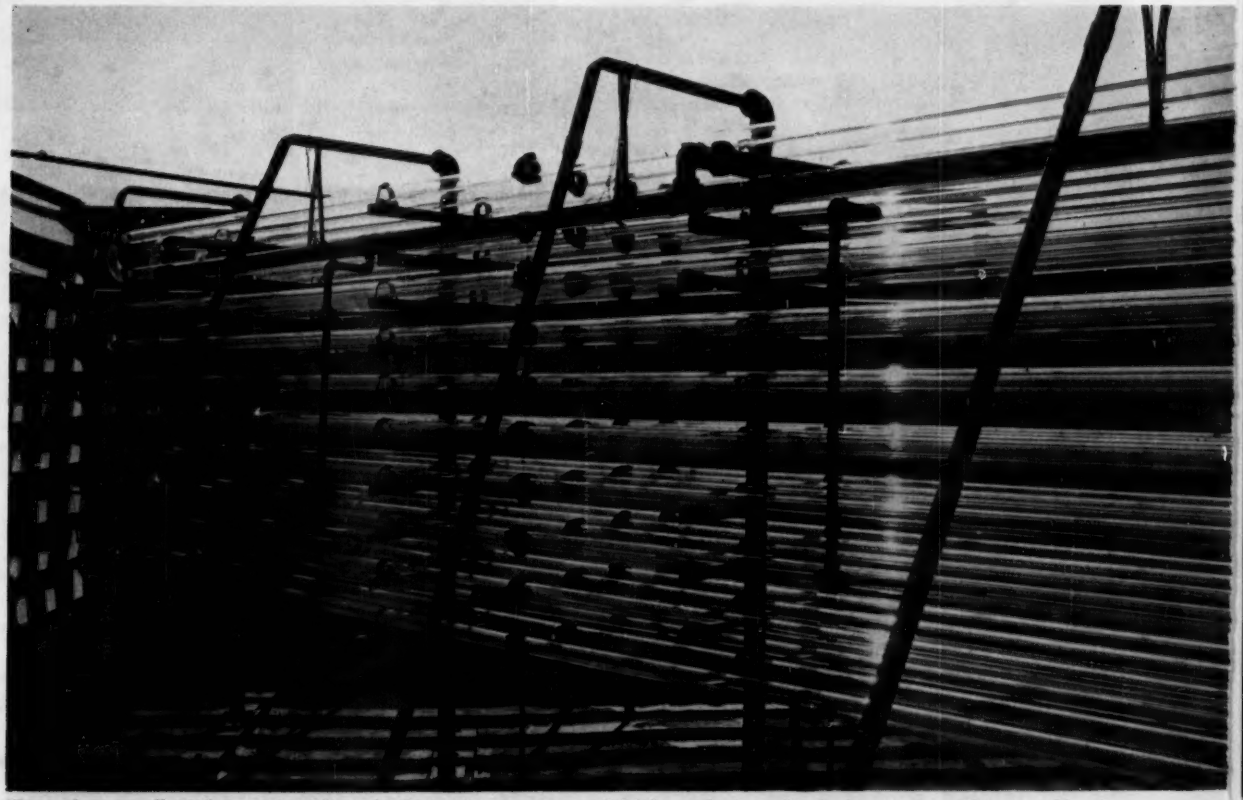
### High Alloys Better Than Stainless

The high-alloy steels such as Worthite and the 20 alloys are useful under conditions of temperature and concentration at which the ordinary stainless steels are no longer satisfactory. Erosion-corrosion resistance is much superior to stainless steels.

The 20 alloys show considerable resistance to sulfuric acid at all concentrations to 140 F., and below 20% to the boiling point. In sulfuric-nitric mixtures, they will handle all concentrations containing 1% or more $HNO_3$ to 212 F.

### Titanium, Zirconium Resist Oxidizers

Titanium combines excellent corrosion resistance to



**Glass pipe: excellent for most acids and where transparency and high product purity is important. (Corning Glass)**

### Specifications for carbon steel pipe—Table II

| ASTM | Grade | Scope | Max. Temp., °F. | Max. Allowable Fiber Stress, Psi.† | Note |
|---|---|---|---|---|---|
| **For steam up to 125 psi. and 450 F.** | | | | | |
| A-120 | A and B | Seamless | ..... | ..... | Not for close coiling or bending |
| A-120 | A and B | Electric welded | ..... | ..... | Over 4 in.—not for close coiling or bending |
| A-120 | | Butt or lap welded | ..... | ..... | Not for close coiling or bending |
| **For steam up to 250 psi. and 750 F.** | | | | | |
| A-134 | .. | Electric-fusion welded | ..... | ..... | Over 16 in. |
| A-134 | A | Electric-fusion welded | ..... | ..... | 4 in. and over—adapted for flanging and bending |
| A-134 | B | Electric-fusion welded | ..... | ..... | 4 in. and over—not for flanging and bending |
| **For steam up to 600 psi. and 750 F.** | | | | | |
| A-53 or 106 | A | Seamless | 1,100 | 1,000 | For close coiling or cold bending |
| A-53 or 106 | B | Seamless | 1,100 | 1,000 | Not for close coiling or cold bending |
| A-53 | A | Electric-resistance welded | 1,100 | 850 | For close coiling or cold bending |
| A-53 | B | Electric-resistance welded | 1,100 | 850 | Not for close coiling or cold bending |
| A-53 | .. | Butt welded | ..... | ..... | 4 in. and under |
| | | Lap welded | ..... | ..... | Over 4 in. |
| A-135 | A | Electric-resistance welded | 1,100 | 850 | Adapted for flanging and bending |
| A-135 | B | Electric-resistance welded | 1,100 | 850 | Not for flanging and bending |
| **For steam above 600 psi. and to 1,100 F.** | | | | | |
| A-155 | Class I | Electric-fusion welded | 1,100 | 1,000 | Adapted for flanging and bending |
| (Note: Graphitization may occur above 750 F.) | | | | | |
| **For low-temperature service to —50 F.** | | | | | |
| A-333 | C | Seamless or welded | —50 | 15,600 | |

† Maximum allowable pressure at the temperature given. Schedule no. = 1,000 $P/S$ where $P$ is maximum internal service pressure in psig. and $S$ is maximum allowable fiber stress in psi.

### Important specifications on alloy steel—Table III

| ASTM | Grade | Scope | Max. Temp., °F. | Max. Allowable Stress, Psi.† | Note |
|---|---|---|---|---|---|
| **For high temperature and pressure** | | | | | |
| A-155 | Class I, ½ Cr | Electric-fusion welded | ..... | ..... | Size 16 in. and over suitable for flanging and bending |
| A-155 | Class I, 1 Cr | | ..... | ..... | Alloys also contain ½ Mo |
| **To resist graphitization in steam above 600 psi. and under 1,100 F.** | | | | | |
| A-158 or A-335 | P3a | Seamless | ..... | ..... | 1.75 Cr, 0.70 Mo |
| | P3b | | 1,200 | 1,200 | 2.0 Cr, 0.55 Mo |
| | P3 | | 1,200 | 1,200 | 1.75 Cr, 0.55 Mo |
| **For steam above 400 psi. and under 1,100 F.** | | | | | |
| A-206 or A-335 | P-1 | Seamless | ..... | ..... | 0.55 Mo |
| | | | 1,100 | 2,400 | |
| **For steam above 600 psi. and 1,100 F.** | | | | | |
| A-280 or A-335 | P-2 | Seamless | ..... | ..... | 0.65 Cr, 0.55 Mo |
| | | | 1,100 | 2,400 | Suitable for bending, flanging and fusion welding |
| **For steam above 600 psi. and up to 1,100 F.** | | | | | |
| A-315 or A-335 | P-12 | Seamless | ..... | ..... | 1.00 Cr, 0.50 Mo |
| | | | 1,200 | 1,000 | Suitable for bending, flanging and fusion welding |
| **For low-temperature service** | | | | | |
| A-333 | 3 | Seamless or welded | —150 | 21,650 | To —150 F. |

oxidizing media with considerable resistance to solutions containing halogens. A recent Ti alloy, containing 0.1% Pd, has improved resistance to reducing media such as hot, dilute acids.

Zirconium has excellent resistance to hot, concentrated mineral acids (particularly HCl), strong alkaline solutions, fused caustics.

In white fuming nitric acid, Ti and Zr are useful up to the boiling point. However, note that titanium should not be used with red fuming nitric acid because of the danger of stress-corrosion cracking.

In hydrochloric acid, Ti plus 0.1% Pd alloy has useful resistance to concentrations up to 15% and 140 F. Zirconium will handle up to 20% solutions to 212 F. Zirconium will also handle sulfuric acid up to 70% to the boiling point.

In general, both metals have excellent resistance to chloride solutions to 212 F. Exceptions are hot concentrated (25%) aluminum chloride, which corrodes titanium, and cupric and ferric chloride, which corrodes zirconium even at moderate temperatures.

### Aluminum Competes With Steel

Aluminum is a most useful material for piping. It is a lightweight metal and installed costs compare favorably with steel (on a per ft. basis). The standard pipe alloys are 3003, 6061 and 6063.

Aluminum has excellent corrosion resistance to a wide variety of products at moderate temperatures, including: glacial acetic acid, acetic anhydride, gluconic acid, propionic acid, sulfuric acid above 98%, liquid or gaseous fluorine.

Aluminum also has special advantages in the rocket-

**Limitations on stainless pipe—Table IV**

| ASTM | Grade | Max. Allowable Temp., °F. | Max. Allowable Stress, Psi. | Note |
|---|---|---|---|---|
| **Pipe, seamless** | | | | |
| A-158 | p8a | | | AISI 304 |
| | p8b | | | 321 |
| | p8d | | | 347 |
| | p8a Mo | | | 316 |
| A-312 | TP 304 | 1,500 | 750 | |
| | TP 304L | 800 | 8,100 | |
| | TP 309 | 1,500 | 750 | |
| | TP 310 | 1,500 | 750 | |
| | TP 316 | 1,500 | 1,500 | |
| | TP 316L | 800 | 8,800 | |
| | TP 317 | 1,500 | 1,500 | |
| | TP 321 | 1,500 | 1,000 | |
| | TP 347 | 1,500 | 1,000 | |
| **Pipe, welded** | | | | |
| A-312 | TP 304 | 1,500 | 600 | |
| | TP 304L | 800 | 6,450 | |
| | TP 309 | 1,500 | 600 | |
| | TP 310 | 1,500 | 600 | |
| | TP 316 | 1,500 | 1,200 | |
| | TP 316L | 800 | 7,050 | |
| | TP 317 | 1,500 | 1,200 | |
| | TP 321 | 1,500 | 800 | |
| | TP 347 | 1,500 | 800 | |

**Nickel alloy seamless pipe—Table V**

| ASTM | Grade | Material | Max. Allowable Temp., °F. | Max. Allowable Stress, Psi. | Note |
|---|---|---|---|---|---|
| B-161 or B-163 | Nickel | | 600 | 1,000 | Annealed |
| | Low C nickel | | 1,200 | 1,200 | Annealed |
| B-163 or B-167 | Ni-Cr-Fe (Inconel) | | 1,200 | 2,000 | Annealed |
| B-163 or B-165 | Ni-Cu (Monel) | | 900 | 8,000 | Annealed |

**Aluminum and copper alloy seamless – Table VI**

| | | | | | |
|---|---|---|---|---|---|
| **Aluminum and alloys** | | | | | |
| B-210 | 996A | 1060 | 400 | 1,600 | H 14-18 temper |
| | M1A | 3003 | 400 | 3,500 | H 18 |
| | MG11A | 3004 | 400 | 3,500 | H 34-38 |
| | CG42A | 2024 | 400 | 3,950 | T 3 |
| | G1A | 5050 | 400 | 3,500 | H 34-38 |
| | GR20A | 5052 | 400 | 3,500 | H 34-38 |
| | GR40A | 5154 | 300 | 7,900 | H 34-38 |
| | GS11A | 6061 | 400 | 4,000 | T 6 |
| | GS11A | 6061 | 400 | 3,200 | Welded |
| | GS10A | 6063 | 400 | 2,100 | T 4 |
| | GS10A | 6063 | 400 | 1,900 | Welded |
| **Copper and alloys** | | | | | |
| B-42 | | | 500 | 750 | |

fuel field where it is preferred over stainless for handling such materials as: white and red fuming nitric acid, 90% to anhydrous hydrogen peroxide, hydrazine, unsymmetrical dimethyl hydrazine (dilute aqueous solutions excepted). Aluminum is also useful for handling acid gases ($H_2S$ and $SO_2$).

While not generally recommended for alkaline media, aluminum is completely resistant to ammonia when appreciable amounts of $CO_2$ are present.



**Stainless pipe:** no panacea but the most widely used material for corrosive service. (Committee of Stainless Producers)

Note that many of the methods used to connect pipe to fittings are not appropriate for aluminum. Soldering, for instance, is impractical because of contamination from the flux and the difficulty of completely removing excess flux from the pipe interior. For similar reasons, brazing of pipe to fittings is not usually recommended.

Threaded fittings are available. But it should be noted that extreme care is called for in threading aluminum pipe—special lubricants are required to minimize galling.

To avoid any flux contamination, welding of aluminum pipe must be performed under an inert atmosphere. Sound, pressure-tight welds in all positions can be made by moderately skilled welders using the tungsten-arc method.

## New Developments in Aluminum

A number of interesting developments should be mentioned concerning aluminum pipe. Some manufacturers market a steam-traced pipe in which the steam line is an integral part of the pipe. This design requires special flanges and gaskets. Another innovation is heavy-end pipe, where heavy ends provide the strength needed for the joint, but excess metal is

eliminated from the pipe body. This pipe is available in schedule 40 and 80 equivalents, and it can take standard fittings. Claimed savings are 27% over standard aluminum pipe, before installation.

Also, use of socket-weld fittings appears to be gaining favor with aluminum, although butt-weld connections are more common. Butt-weld fittings are relatively inexpensive, but in many cases they need a backing ring to insure that the weld does not leave obstructing weld metal on the inside surface of the joint. Socket fittings are heavy forgings, drilled to match the pipe interior. When the pipe is seated to the full length of the socket, only a simple fillet weld is needed to complete the joint. Probably, this type of fitting will gain popularity in small sizes (below 2 in.), where it can compete with butt-welded units on a cost basis.

### No Oxygen for Copper and Monel

Copper alloys, when properly chosen, will handle a variety of corrosive products. Their use is limited chiefly by the presence of oxygen. Thus, they cannot be used with strong oxidants such as nitric or chromic acid, or compounds such as ferric chloride or ferric sulfate that have oxidizing properties. In many other environments, they provide useful resistance where there is no aeration.

Use of high-zinc alloys (15% Zn) should be avoided in acid, alkaline or salt solutions because of possible dezincification.

At room temperature, copper alloys are not attacked by dry gases such as ammonia, chlorine and bromine. However, the presence of moisture is usually detrimental.

Monel (67% Ni, 30% Cu) has useful resistance to many corrosive reducing environments. The presence of air or oxidants will accelerate corrosion. For this reason, it may show better resistance to boiling solutions than to solutions at lower temperature that contain dissolved oxygen. This is generally true, for instance, in acetic acid solutions.

Corrosives that are handled satisfactorily by Monel, with due regard to limitations imposed by the presence of oxidizing agents, include: hydrofluoric acid (all concentrations of aqueous solutions to 300 F.); anhydrous HF (at elevated temperatures); sodium chloride (suitable for evaporators); phosphorous oxychloride (at reflux); phosphorous trichloride (at 290 F.); liquid bromine (wet or dry 130 F.); fluorine (to 900 F.); unsymmetrical dimethyl hydrazine (no known limitations).

### Nickel Alloys for Acids

Like Monel and copper, nickel is susceptible to corrosion under oxidizing conditions, although less sensitive in this respect than copper alloys. It is also susceptible to corrosion by sulfur compounds.

Severely corrosive media in which nickel has useful resistance include: anhydrous HCl (to 930 F.); dry chlorine (to 1,000 F.); dry fluorine (to 900 F.); liquid bromine (to 130 F. wet or dry); phosphorus tribromide (at ambient temperature) and concentrated (73%) hot caustic soda.

Inconel, a chromium-nickel alloy (14-17% Cr, 72% Ni, 6% Fe) combines excellent high-temperature strength and corrosion resistance. It is immune to embrittlement by carburizing and nitriding atmospheres. The chromium content makes Inconel superior to nickel under high-temperature oxidizing conditions and Inconel is suitable for some reducing environments (1,000 F. in a reducing sulfurous atmosphere).

Hastelloy alloys are particularly useful for handling acids under the most severe conditions.

Hastelloy B (61% Ni, 28% Mo) is resistant to all HCl concentrations to the boiling point. Hastelloy C (54% Ni, 16% Cr, 16% Mo) is resistant to concentrations of HCl up to 20% at 160 F., and higher at room temperature. Both alloys resist anhydrous HCl to 840 F. and iodine vapors to 575 F.

Hastelloy C shows excellent resistance to hypochlorite solutions, strong oxidizing agents containing ferric chloride or cupric chloride, wet chlorine gas and chlorine dioxide solutions.

### Lead and Silicon Irons

Lead has long been popular for handling sulfuric-acid solutions. It is satisfactorily resistant to solutions up to 65% to the boiling point, 65 to 80% concentrations to about 300 F., and 80 to 96% at ambient temperatures.

It can be used to handle all concentrations of hydrochloric acid to 175 F. For concentrations above 20%, chemical lead (99.90% Pb) is preferred. However, at concentrations below 20% and temperatures of 160 to 212 F., antimonial lead is best.

Lead is also resistant to all concentrations of hydrofluoric acid to 60% at ambient temperatures and can be used in chlorine and bromine service. The presence of moisture does not materially affect corrosion by chlorine but accelerates it in bromine. As pipe, lead has disadvantages: high density, poor mechanical properties.

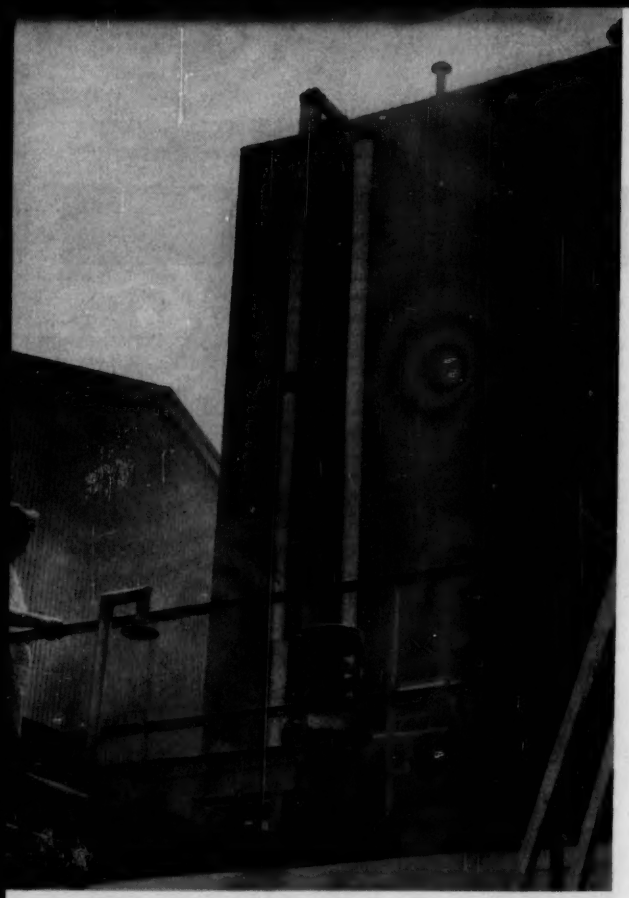
The silicon irons have outstanding resistance at all temperatures to sulfuric acid up to 100% and nitric acid, including white and red fuming acid. The addition of Mo, as in Durichlor, results in similar resistance to HCl to 300 F.

Because of the silicon content, these alloys are not resistant to hydrofluoric acid or highly alkaline media. Their resistance to most other media approaches that of glass.

Silicon-iron pipe is brittle and there is the danger of breakage due to mechanical shock. In critical areas, this may be overcome by wrapping with glass fabric impregnated with polyester or epoxy resin.

### Glass Tops for Acids

In acids and acidic materials, glass offers greater resistance than any other material except the fluorocarbons. Hydrofluoric acid and phosphoric acid con-



**Vertical Teflon-lined pipe goes to top of ammium nitrate reactor at Atlas Powder Co., Joplin, Mo. (Resistoflex)**

taining fluorides are exceptions. Glass is also subject to attack by hot alkaline solutions. At room temperature, it will resist alkaline solutions and even mild HF solutions.

Glass is particularly suitable for process piping where transparency is desirable and product contamination is to be avoided.[6]

Chief drawback is, of course, brittleness. Glass is also susceptible to breakage due to thermal shock. Much work, however, has been done to produce stronger and more durable products and where properly installed and protected from possible mechanical or thermal shock, glass may often offer a most economical material for process piping.

Armoring glass pipe with polyester-reinforced glass fabric provides protection against breakage. This technique not only increases the resistance of the pipe to mechanical shock but also forms a protective plastic shield in case breakage does occur.

Armored glass pipe is available from the manufacturer but armoring may also be done at the plant site.

## Impervious Graphite Very Inert

Graphite is completely inert to all but the most highly oxidizing conditions. The chemical resistance of impervious graphite is, therefore, dependent on resistance of the resin binder. Some limitations are:

- High concentrations of organic acids.
- Concentrated alkali where a phenolic resin binder is used.

Furan or epoxy resins may extend the usefulness of impervious graphite in handling alkaline materials.

The useful range of impervious graphite may also be extended by decreasing the ratio of binder to graphite. This has been done experimentally with considerable success but the process has not been perfected to a point where equipment is generally available.

Impervious graphite has been found particularly useful for handling all concentrations of HCl and HF to the boiling point, and in phosphoric-acid service. Poor mechanical strength limits its use for pipe, and graphite is more popular in heat-exchange equipment.

## Plastics Complement Metals

In comparison with metallic materials, the use of plastics, except as linings, is limited to relatively moderate temperatures and pressures (Table I). Plastics are also less resistant to mechanical abuse. When properly selected and installed, however, they can handle a very wide range of corrosive fluids.[5, 4, 5]

Since plastics do not corrode in the electrochemical sense, they offer a distinct advantage over metallic materials—they are not apt to be affected by minor impurities in the corrosive medium. A change in pH from 5 to 4 can result in rapid corrosion of low-alloy steel, or a few parts per million of chlorides may cause serious damage to stainless steel. Moderate aeration will often render copper alloys useless. For practically any metal or alloy, a slight change in the environment, often easily overlooked, may spell the difference between success and failure. In this respect, plastics can be specified with considerably more confidence than alloy materials, where resistance to the major constituents of the corrosive medium is assured.

Generally speaking, plastic materials used for piping have good to excellent resistance to weak mineral acids and are unaffected by inorganic salt solutions. Phenolic-asbestos, general-purpose polyester-glass, saran and cellulose-acetate-butyrate (CAB) are adversely affected by alkalis while polyethylene, acrylonitrile-butadiene-styrene (ABS), polyvinyl chloride, bisphenol-based polyester-glass and the epoxy-glass are resistant to alkalis.

There is considerable variation in wet-acid gases. Only ABS, PVC and phenolic-asbestos show good general resistance. In organic substances, the thermoplastic materials are generally poor while the thermosetting resins show good resistance.

## Lined Pipe Cuts Costs

Lining pipe with a metallic material or a plastic is a particularly active area of the piping business. And the reason is fairly obvious. A carbon-steel pipe lined with an alloy may cost 50% less than solid-alloy pipe.

Metal-coated pipe has been available for some time. Nickel, for instance, can be deposited by electroplating

(although this coating is somewhat porous) or by electroless techniques (Kanigen or Niphos). Stainless-clad pipe is also available, fabricated from clad sheet. A deposited-alloy coated pipe will cost about 50-60% less than solid alloy; the clad pipe is 10-50% less, depending on pipe diameter.

Welded joints are a major problem with alloy-lined pipe, since the steel and alloy are usually not compatible under welding heat. Lukens Steel has solved this problem for clad pipe, with a welding technique that calls for a transition weld between the stainless and the carbon steel.[11]

When plastics are used as lining materials in steel pipe, they become very versatile materials. Common practice, involving 150-lb. valves and flanges, sets 150 lb. as the maximum allowable working pressure. Plastic linings on steel can handle this pressure for the entire temperature range in all pipe sizes. On the other hand, unsupported plastics, including the reinforced thermosets, suffer serious limitations in allowable working pressure with increasing temperature or pipe size (Table I)).

As for plastic-lined pipe, the choice is between PVC, saran, rubber or Teflon. (A recent development has been the availability of Penton-lined equipment, including pipe.) A Teflon-lined pipe producer claims its product is only slightly more expensive than 316 stainless steel when final installed costs are compared. Such a claim is based on the fact that Teflon-lined pipe comes equipped with flanges and gaskets and needs only bolting to install. Therefore, while material costs are high for the lined pipe, low installation costs cut the final cost down to a reasonable level. However, such pipe requires very precise piping layouts and little chance for changes in the field.

Glass-lined pipe, of course, has been available for many years. One relatively new development is glass-lined ductile-iron fittings that are much stronger than usual cast iron (Teflon-lined pipe also comes with ductile-iron fittings). Another is lined pipe that can be cut and threaded in the field by plant maintenance crews—this eliminates the necessity for precise piping layouts and permits field changes during installation of glass-lined pipe.

**Compare relative costs of materials—Table VII**

| Material | Pipe Only-Cost Ratio (100 Ft., 2-in., Sch. 40, C S = 1) | Total Installed Cost Ratio* (C S = 1) |
|---|---|---|
| Material | | |
| Carbon stl. welded, A120 | 1.0 | 1.0 |
| Carbon stl. seamless | 1.4 | |
| Wrought iron | 2.2 | |
| Aluminum 3003 | 1.9 | 1.2 |
| Aluminum 6061 | 2.3 | |
| Copper | 6.4 | 2.0 |
| Everdur 1010 | 8.7 | |
| 304 | 13.8 | 2.9 |
| 304L | 18 | |
| 309 | 22 | |
| 316 | 19 | 3.7 |
| 316L | 21 | |
| 317 | 30 | |
| 321 | 16.5 | |
| 347 | 20 | |
| Monel | 18.2 | 3.8 |
| K Monel | 23 | |
| A Nickel | 19.5 | 4.3 |
| Nickel-lowC | 20 | |
| Inconel | 23 | 4.8 |
| Incoloy | 21 | |
| Inconel X | 64 | |
| Hastelloy B (sch. 10) | 44 | |
| Hastelloy C (sch. 10) | 43 | 5.0 |
| Hastelloy D (Sch. 80) | 48 | |
| Hastelloy F | 73 | |
| 20 Alloys | 40 | 5.6 |
| Titanium | 86 | |
| Polyethylene | 1.2 | |
| CAB | 1.3 | 1.2 |
| ABS (sch. 80) | 2.7 | 1.7 |
| PVC (sch. 80) | 2.7 | 2.0 |
| Phenolic asbestos | 10.8 | 2.9 |
| Epoxy glass | 6.8 | 2.7-4 |
| Saran lined (3/16-in. lining) | 7.4 | 3.0 |
| Rubber lined (1/8-in. lining) | 8.0 | 3.1 |
| Teflon lined (0.070 in.) | 30 | 4.3 |
| Glass lined (0.050 in.) | 39 | 5.5 |
| Glass | 8.6 | |

* Includes cost of valves and fittings, fabrication and erection. Includes quantity discounts. Based on a typical process-piping system with about 1 joint/ft. of pipe, 1959 prices. Data based on Ref. 10. Use table only for rough, order-of-magnitude estimates.

## Economic Analysis Decides Winner

Most of the pipe materials discussed here are available in the usual O.D. size range of ¼ to 8 in. However, epoxy-glass is made mainly in the 2 to 8-in. range; glass pipe is available up to 6 in.; lined pipe generally runs from 1 to 8 in.

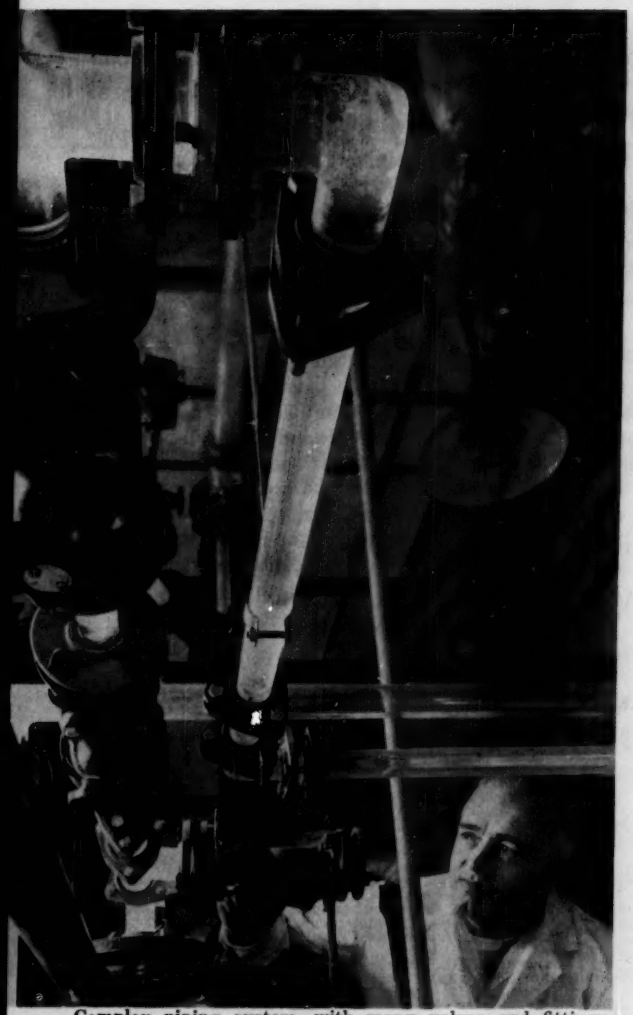
When estimating the cost of a piping system, the following should be considered:

- Total materials cost including valves and fittings.
- Labor costs to install.
- Savings due to elimination of unscheduled shutdowns.
- Replacement cost.

When all these factors are taken into account, final costs bear little relationship to the cost of the pipe alone (Tables VII, VIII).

Labor costs for installing pipe vary widely because of different installation methods for various materials. For instance, glass-lined steel pipe, fabricated to length or field cut, calls for special gaskets that seat with low bolt pressures. Many resistant metals and alloys require welded joints and inert atmospheres around the weld. PVC and ABS plastic pipe require handsaw cutting, dressing of ends and heat sealing or cementing. Epoxy reinforced with glass is cut with a handsaw after heating, and pipe and socket are joined with cement. Teflon-lined pipe is fabricated to length with flanges and gaskets (flared section of the lining) in place.

For process piping, where a large number of fittings and joints are involved (as high as 1 joint/ft.), labor costs for installing pipe can become a major factor. Labor costs for installing Teflon-lined pipe will amount



**Complex piping** system, with many valves and fittings, complicates job of making economic choice. (Corning Glass)

to about 25% of the total piping-system cost. For ABS and PVC, labor costs may run as high as 75% of the total.[10]

Naturally, there is a large variation between different piping systems—some may have a large number of fittings, others may involve straight pipe runs with few fittings. In some, installation costs can be more important than in others. But the chances are that such costs will radically change the material-cost relationships.

To carry this analysis one step further, the code allowable "S" for any material (Tables II-VI) can be used to determine minimum allowable thickness, and cost comparisons made on this basis, instead of on equal wall thickness.

And cost considerations should not stop with installed cost. Maintenance is necessary to keep any system going. A real basis for comparison should be total annual cost of the piping system (see Table VIII.)[10] The difficulty with such an analysis has perhaps discouraged some people from constructing such tables —on new or untried material, there is a big uncertainty factor connected with "estimated life." However, laboratory tests can give some rough estimates of life and an order-of-magnitude-estimate of savings.

## Specifications Abound for Metals

*Metallic Materials*—Specifications for pipe of various metals and alloys are listed in Tables II-VI. The abundance of data available on physical properties of conventional metallic materials makes specification, as far as operating conditions of temperature and pressure are concerned, relatively simple. Choice of the right material to resist corrosion is more difficult but the necessary information is generally available.

Besides the various ASTM specifications for metals, one of the "bibles" for piping engineers is the American Standards Assn.'s pressure-piping code ASA B31.1-1955. Several sections of this code have been revised recently, particularly B31.3-1959, the code for petroleum piping.

*Steel, Plastic Lined* — Standard specifications for various types of plastic-lined pipe are not nationally available as yet. As a result, procurement of poor-quality material can cause costly failures. Various manufacturers and users of plastic materials, however, have developed their own specifications, and certain vendors have been qualified to supply products meeting such specifications. Rubber-lined and Teflon-lined steel, for instance, can be supplied that conform to Du Pont standard engineering specifications.

*Unsupported Plastics*—As in the case of plastic materials used as liners, specifications for unsupported-plastic pipe are not generally available.

**Maintenance, replacement affect costs—Table VIII**

| | Material A | Material B | Material C |
|---|---|---|---|
| Installed cost (investment) | $45,000 | $65,000 | $60,000 |
| Additional cost over A | ..... | $20,000 | $15,000 |
| Estimated life, years | 4 | 6 | 10 |
| Estimated maintenance rate, % | 10 | 7 | 5 |
| Annual replacement cost (*Installed cost ÷ Life*) | $11,250 | $10,830 | $6,000 |
| Annual maintenance cost (*Installed cost × Rate*) | $4,500 | $4,550 | $3,000 |
| Total annual cost | $15,750 | $15,380 | $9,000 |
| Annual savings vs. cost for A | ..... | $370 | $6,750 |
| Tax on savings @ 50% | ..... | $185 | $3,375 |
| Net annual savings | ..... | $185 | $3,375 |
| Return on investment over A (*Net savings ÷ Additional cost*) × 100 | ..... | 0.9% | 22.5% |

To ensure satisfactory results with thermoplastics for corrosion service, it is best to use the more resistant materials such as PVC Type I and ABS. These materials are well standardized and should be reliable. Use only for moderate temperature and pressure service and ensure proper support.

The thermosetting, reinforced materials can be used for higher temperatures and pressures but it must be remembered that the relatively high creep rate exhibited by all plastic materials can lead to eventual failure. From this standpoint, it is unwise to rely on short-time tensile properties.[7] It is better to rely on allowable working temperature and pressure as recommended by the manufacturer. Typical values are shown in Table I. Proper support is also important with some of the reinforced thermosets.

Long-term tests have indicated that following maximum support spacing for plastic pipe:

- Thermoplastics: 8 ft. to continuous, depending on temperature.
- Phenolic- and furan-asbestos: 3 ft.
- Epoxy- and polyester-glass: approaching that of steel.

To obtain a satisfactory reinforced-plastic pipe, the following should be specified:

1. No paint, coating or unreinforced resin layer should be applied to any surface after fabrication unless specifically requested. If such coating is to be applied, the pipe should be subject to inspection before application.
2. All interior and exterior surfaces should be uniform in color and texture.
3. There should be no indication of resin-starved reinforcing, or areas with clear resin without reinforcing.
4. The surface should be without gouges, pits, cracks or crazing.
5. Translucent materials should show no marked changes in translucency unless there is a change in section.
6. There should be no markedly hard or soft spots.

## Design and Mechanical Factors

To assure success of a piping system, various factors should be considered from a corrosion standpoint.

Crevices formed at joints in metallic pipe can be a focal point for corrosion. This is particularly true for stainless alloys. Care should be taken in selecting gaskets that cover the entire face of flanges and that do not have wicking action, as is the case with some asbestos-filled materials.[8] From a corrosion standpoint, welded joints assuring complete penetration may be preferable.

Where high velocities are apt to accelerate corrosion, piping should be sized so that critical velocity will not be exceeded. To prevent high local velocities due to turbulence at elbows, it may be advisable to use sweep bends.

When piping is used intermittently, it is a good idea to provide sufficient pitch so that the line can be drained completely during idle periods.

External heating by direct sunlight may tend to accelerate corrosion or may be detrimental to certain plastic linings. In such cases, insulation should be provided.

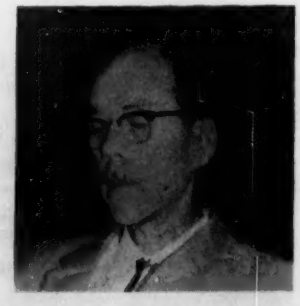
Galvanic action can cause serious corrosion in a piping system where dissimilar metals are coupled together. Use of high-alloy valves or pumps in a steel or stainless-steel system is a case in point. Where such effects are apt to cause trouble, the valves, etc., should be electrically insulated from the pipe. Nonconductive plastic gaskets, bolt sleeves and washers are available for use where flanged connections are employed. For screwed joints, plastic-lined couplings should be used.

In the case of plastics, suitable joining methods may cause some concern. All the plastics considered here can be assembled by means of either screwed or flanged joints. In addition, CAB, ABS and PVC can be joined with solvent-welded socket fittings. PVC Type I and saran can be thermal welded and epoxy- and polyester-glass can be joined by wrapping with glass fabric impregnated with catalyzed liquid resin. Of the various joining techniques, screwed connections are least desirable (leakage, decrease in strength at the threaded ends).

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Meet the Author




C. K. ALDRICH, *now a consulting engineer, has devoted 25 years to corrosion work. After a short stint with International Nickel, he joined American Cyanamid and since then has been concerned with corrosion and materials of construction problems for various Cyanamid plants. From 1956 to 1960, he was a corrosion and materials engineer in Chemical Construction's pilot plant in North Brunswick, N. J.*

# Directory of Manufacturers

2 *To help solve your construction-material supply problems: an up-to-date directory (published every two years) of who makes what in basic corrosion-resistant materials of construction. By basic materials, we mean standard mill forms such as rods, tubes, bars, pipe, sheet, pellets, powder, etc. The companies included are major suppliers to the chemical process industries. Note that coatings and joining materials are not included.*

*This directory can be used in two ways:*

*1. To find all the companies making a particular product, use the Material Classification section below. Here, following each material, is a list of manufacturers' code numbers which refer to the Listing of Basic Manufacturers beginning on page 195.*

*2. To find what products a particular company makes, go directly to the listing of manufacturers. Here, following each company, is a list of material code numbers which refer to the material classification section.*

## Material Classification and Company Index

*This first section of the directory includes a material classification and an index to manufacturers. Two codes are used: a material code number and a manufacturer code number.*

| MATERIAL CLASSIFICATION | MAT'L. CODE | MANUFACTURERS' CODE NUMBERS |
|---|---|---|
| **Ferrous metals and alloys** | | |
| Irons | 1 | 32, 42, 61, 71, 79, 114, 119, 145, 153, 159, 162, 208, 219, 237 |
| Carbon steels | 2 | 22, 25, 33, 36, 44, 63, 68, 71, 79, 84, 114, 119, 123, 134, 135, 150, 155, 159, 161, 162, 167, 171, 188, 197, 208, 215, 219, 222, 227, 237, 240, 241 |
| Low-alloy steels | 2 | 23, 25, 33, 35, 36, 63, 66, 68, 71, 114, 119, 134, 135, 149, 150, 155, 161, 162, 167, 171, 197, 208, 215, 219, 222, 227, 237, 240, 241, 256 |
| Carbon steels clad or bonded with . . . | | |
| Glass | 3.1 | 110, 185, 210, 237 |
| Alloys | 3.2 | 38, 57, 63, 132, 155, 237 |
| Other | 3.3 | 12, 27, 38, 57, 110, 134, 141, 170, 185, 204, 215, 237 |
| Wrought stainless | | |
| AISI 200 series | 4.1 | 3, 18, 55, 71, 72, 132, 135, 159, 162, 197, 208, 215, 229, 240, 243, 249, 251, 68 |
| AISI 300 series | 4.2 | 3, 18, 22, 25, 34, 36, 40, 44, 50, 51, 52, 55, 71, 72, 81, 100, 123, 124, 132, 135, 149, 159, 162, 192, 197, 208, 215, 219, 227, 229, 223, 236, 237, 240, 241, 243, 248, 249, 251, 68 |
| 304 | 4.2.1 | 3, 18, 22, 25, 34, 36, 44, 50, 51, 52, 55, 71, 72, 81, 100, 123, 132, 135, 149, 159, 162, 192, 197, 208, 215, 219, 227, 229, 236, 240, 241, 243, 248, 249, 251 |
| 316 | 4.2.2 | 3, 18, 22, 25, 34, 36, 44, 50, 51, 52, 55, 71, 72, 81, 100, 123, 132, 135, 149, 159, 162, 192, 197, 208, 215, 219, 227, 229, 231, 236, 240, 241, 243, 248, 249, 251 |
| 347 | 4.2.3 | 3, 18, 22, 25, 34, 36, 44, 50, 51, 52, 55, 71, 72, 81, 100, 123, 132, 135, 159, 162, 192, 197, 208, 215, 219, 227, 229, 236, 240, 241, 243, 248, 249, 251 |
| AISI 400 series | 4.3 | 3, 18, 25, 33, 34, 36, 44, 50, 51, 52, 55, 71, 92, 100, 123, 124, 132, 135, 149, 159, 162, 188, 192, 197, 208, 219, 227, 223, 236, 240, 241, 243, 249, 251, 68 |
| AISI 500 series | 4.4 | 33, 36, 50, 51, 52, 55, 71, 135, 162, 197, 208, 219, 227, 240, 243, 249 |
| Precip. hardening stainless | 4.5 | 3, 18, 25, 34, 40, 44, 50, 55, 66, 71, 72, 84, 100, 123, 124, 135, 162, 192, 219, 229, 240, 243, 249 |
| 20 alloys | 4.6 | 34, 51, 52, 55, 71, 72, 100, 123, 135, 162, 229, 236, 243 |
| Other | 4.7 | 52, 135, 162, 213, 227, 245, 249 |
| Cast high alloys (ACI types) | | |
| Corrosion-resistant grades | | |
| Iron-Cr | 5.1.1 | 6, 9, 14, 22, 30, 66, 78, 79, 84, 87, 100, 119, 132, 150, 163, 213, 222, 230, 237, 245, 252, 35 |
| Iron-Cr-Ni | 5.1.2 | 6, 9, 14, 22, 30, 66, 78, 79, 84, 87, 92, 100, 119, 132, 150, 163, 213, 222, 229, 230, 237, 245, 252, 35 |
| Other | 5.1.3 | 66, 79, 87, 100, 119, 150, 163, 222, 237, 35 |
| Heat-resistant grades | | |
| Iron-Cr-Mo | 5.2.1 | 22, 30, 66, 71, 78, 100, 119, 150, 163, 237, 245, 252, 35 |
| Iron-Cr | 5.2.2 | 9, 22, 30, 44, 66, 71, 78, 84, 87, 92, 100, 119, 132, 150, 163, 237, 252, 35 |
| Iron-Cr-Ni | 5.2.3 | 9, 22, 30, 44, 66, 71, 78, 79, 84, 87, 92, 100, 119, 132, 150, 163, 215, 237, 245, 252, 35 |
| Other | 5.2.4 | 66, 71, 119, 145, 150, 163, 188, 237, 35 |
| **Aluminum and aluminum alloys** | | |
| 1000 series | 6.1 | 8, 14, 30, 43, 55, 75, 124, 136, 167, 178, 199, 200, 206, 231 |
| 2000 series | 6.2 | 8, 14, 30, 38, 43, 55, 75, 124, 136, 178, 199, 200, 231 |
| 3000 series | 6.3 | 8, 14, 30, 38, 55, 75, 124, 136, 167, 178, 199, 200, 206, 231 |
| 5000 series | 6.4 | 8, 14, 30, 55, 75, 124, 136, 167, 178, 199, 200, 206, 231 |
| 6000 series | 6.5 | 8, 14, 30, 38, 43, 55, 75, 124, 136, 167, 178, 199, 200, 231 |
| Other | 6.6 | 8, 14, 55, 75, 124, 136, 167, 178, 200 |
| **Beryllium and Be alloys** | 7 | 30, 31, 40, 192, 219 |

| MATERIAL CLASSIFICATION | MAT'L. CODE | MANUFACTURERS' CODE NUMBERS |
|---|---|---|
| **Columbium and Cb alloys** | 8 | 34, 38, 77, 89, 137, 140, 217, 219, 231, 235, 243, 245, 247 |
| **Cobalt and Co alloys** | 9 | 30, 44, 95, 213, 215, 219, 230, 245, 249 |
| **Copper and Cu alloys** | | |
| Copper | 10.1 | 10, 14, 17, 30, 38, 55, 60, 167, 172, 178, 186, 199, 206, 231, 252 |
| Copper-Ni alloys | 10.2 | 10, 14, 16, 17, 30, 38, 55, 167, 173, 174, 178, 186, 192, 199, 206, 231, 252 |
| Copper-Sn alloys | 10.3 | 10, 14, 16, 30, 38, 40, 55, 167, 173, 178, 186, 192, 199, 206, 231, 252 |
| Copper-Si alloys | 10.4 | 14, 17, 30, 38, 55, 178, 199, 206, 231, 252 |
| Copper-Al alloys | 10.5 | 10, 13, 14, 16, 17, 30, 38, 55, 167, 178, 186, 199, 206, 231 |
| Copper-Zn alloys | 10.6 | 17, 38, 43, 55, 167, 173, 174, 178, 186, 192, 199, 206, 231 |
| Other copper alloys | 10.7 | 10, 13, 16, 55, 60, 167, 175, 199 |
| **Lead and Pb alloys** | 11 | 14, 30, 41, 141, 170, 182 |
| **Magnesium and Mg alloys** | 12 | 2, 30, 74, 75 |
| **Nickel and Ni alloys** | | |
| Nickel | 13.1 | 6, 30, 34, 79, 84, 87, 95, 130, 150, 188, 192, 213, 219, 231, 243, 248, 252 |
| Nickel-Cu alloys | 13.2 | 6, 14, 16, 22, 30, 34, 44, 79, 87, 123, 130, 150, 192, 213, 219, 231, 245, 248, 252 |
| Nickel-Cr alloys | 13.3 | 6, 22, 30, 44, 79, 87, 92, 104, 123, 130, 150, 192, 213, 230, 231, 241, 243, 245, 248, 252 |
| Nickel-Mn alloys | 13.4 | 14, 30, 130, 231, 243, 245, 248, 252 |
| Nickel-Mo alloys | 13.5 | 6, 30, 79, 87, 130, 213, 230, 231, 243, 245, 248, 252 |
| Nickel-Cr-Fe alloys | 13.6 | 6, 30, 34, 79, 123, 130, 188, 192, 213, 219, 231, 243, 245, 252 |
| Other nickel alloys | 13.7 | 6, 40, 44, 79, 92, 130, 188, 229, 230, 249 |
| **Noble metals** | 14 | 30, 34, 60, 120, 140, 245 |
| **Tantalum and Ta alloys** | 15 | 30, 34, 38, 72, 89, 137, 140, 197, 217, 219, 230, 231, 235, 243, 245, 247, 223 |
| **Titanium and Ti alloys** | 16 | 30, 34, 38, 43, 71, 72, 77, 123, 124, 140, 182, 195, 197, 219, 228, 235, 245, 249, 223 |
| **Tin and Sn alloys** | 17 | 30, 60, 247 |
| **Tungsten and W alloys** | 18 | 89, 92, 104, 140, 217, 220, 231, 243, 245, 247 |
| **Vanadium and V alloys** | 19 | 30, 219, 231, 235, 244, 245 |
| **Zinc and Zn alloys** | 20 | 14, 30, 41, 60, 174 |
| **Zirconium and Zr alloys** | 21 | 3, 17, 30, 34, 38, 43, 46, 48, 55, 64, 72, 95, 124, 182, 195, 217, 219, 229, 245, 247, 249, 259 |
| **Other metals and alloys** | 22 | 10, 30, 46, 55, 60, 89, 92, 160, 178, 217, 220, 231, 245, 247, 249 |
| **Asbestos materials** | 23 | 14, 29, 53, 58, 118, 133, 139, 194, 201, 203, 205, 239 |
| **Carbon and graphite** | 24 | 45, 88, 116, 117, 138, 204, 212, 232 |
| **Ceramics** | | |
| Glass | 25.1 | 69, 125, 151, 152, 180, 181, 189 |
| Fused silica | 25.2 | 69, 189, 225, 226 |
| Chemical porcelain and stoneware | 25.3 | 67, 101, 121, 142, 148, 242 |
| Refractories, brick | 25.4 | 24, 46, 47, 83, 107, 122, 129, 131, 133, 176, 177, 191, 204, 221, 235, 250, 258 |
| Other ceramics | 25.5 | 28, 40, 46, 67, 69, 101, 103, 104, 107, 140, 148, 154, 158, 176, 177, 242, 258 |
| **Plastics** | | |
| Acrylics | 26.1 | 26, 74, 77, 91, 125, 201, 202, 218, 246, 255, 261 |
| ABS polymers | 26.2 | 12, 37, 99, 108, 112, 216, 238, 255 |
| Epoxies | 26.3 | 15, 59, 74, 79, 80, 94, 97, 125, 126, 142, 147, 164, 196, 201, 204, 209, 233, 253, 257, 260 |
| Fluorocarbons | 26.4 | 29, 56, 58, 65, 70, 77, 83, 90, 91, 93, 99, 105, 125, 128, 133, 164, 165, 183, 184, 193, 194, ,198 207, 242 |
| Furanes | 26.5 | 80, 97, 125, 128, 142, 242 |
| Nylons | 26.6 | 4, 29, 49, 77, 90, 91, 99, 105, 125, 190, 201, 207, 211, 218, 246, 255 |
| Melamines | 26.7 | 11, 96, 125, 201, 253 |
| Polyesters | 26.8 | 4, 11,20,54,80, 125, 126, 128, 142, 147, 166, 196, 201, 204, 214, 238, 253, 257, 260 |
| Phenolics | 26.9 | 4, 96,102,103,105,125, 128, 164, 166, 196, 201, 233, 253, 261 |
| Polyethylenes | 26.10 | 5, 12, 49, 54, 74, 77, 82, 91, 99, 115, 127, 134, 143, 166, 168, 169, 179, 187, 193, 211, 216, 218, 233, 241, 242, 246, 253, 255 |
| Polypropylenes | 26.11 | 74, 85, 91, 99, 127, 184, 207, 211, 242, 246, 255 |
| Polyvinyls | | |
| PVC | 26.12.1 | 7, 19, 39, 42, 49, 62, 73, 74, 83, 86, 90, 91, 99, 108, 109, 112, 113, 142, 144, 156, 157, 166, 167, 193, 204, 216, 218, 233, 238, 241, 242, 246, 255, 261 |
| Polyvinylidene Cl | 26.12.2 | 74, 115 |
| Silicones | 26.13 | 29, 76, 106, 234, 242, 246, 253 |
| Other plastics | 26.14 | 1, 77, 82, 94, 97, 99, 103, 112, 175, 184, 189, 190, 207, 233, 246, 255 |
| **Rubber-like materials** | | |
| Natural | 27.1 | 19, 21, 29, 39, 91, 98, 99, 111, 113, 133, 146, 156, 194, 238, 242, 246 |
| Synthetic | | |
| Butadiene-styrene | 27.2.1 | 12, 39, 74, 90, 91, 99, 109, 111, 112, 113, 146, 156, 224, 238, 246, 261 ,262 |
| Nitrile | 27.2.2 | 21, 29, 99, 111, 112, 113, 146, 156, 201, 246 |
| Chloroprene | 27.2.3 | 12, 77, 98, 99, 113, 183, 246 |
| Butyl | 27.2.4 | 19, 21, 29, 83, 85, 99, 111, 112, 113, 146, 238, 246 |
| Polysulfide | 27.2.5 | 246 |
| Silicone | 27.2.6 | 29, 65, 76, 97, 99, 105, 106, 125, 194, 201, 234, 242, 246 |
| Chlorosulfonated polyethylene | 27.2.7 | 21, 77, 98, 99, 113, 246 |
| Other rubber-like materials | 27.3 | 21, 65, 77, 85, 91, 99, 109, 112, 118, 133, 142, 204, 242, 246 |
| **Wood** | 28 | 96, 253, 254 |
| **Other nonmetallics** | 29 | 53, 127, 147, 179, 201, 225 |

## Listing of Basic Manufacturers

*Who makes basic materials of construction and in what forms. For an explanation of the material code numbers and list of all companies making a particular product, see page 193.*

*The following listing is based on a mail questionnaire sent to representative companies in the field. It includes major, basic suppliers of materials of construction to the chemical process industries. Materials, as defined, must come into prime contact with process corrosives. Not included here are joining, paint and coating materials or general construction materials used for buildings, roads, etc. As far as possble, equipment manufacturers are not included, except where they are also material producers.*

| CODE | COMPANY | MATERIAL | TRADE NAME | FORMS | REMARKS |
|---|---|---|---|---|---|
| 1 | Air Reduction Co., Inc., Colton Chemical Co. Div. Cleveland, Ohio | 26.14 | Vinac | Emulsion, powder | Polyvinyl acetate |
| 2 | Alabama Metallurgical Corp. Selma, Ala. | 12 | Alamet | Ingot and pig | High purity primary and Mg-Al-Zn alloys |
| 3 | Allegheny Ludlum Steel Corp. Pittsburgh, Pa. | 4.1 | Allegheny | All necessary forms | Types 201, 202, 204, 204L |
| | | 4.2—4.2.3 | Allegheny | All necessary forms | Types 301, 302, 302B, 303, 304, 304L, 305, 308, 309, 309S, 310, 310S, 314, 316, 316L, 317, 321, 347, 303Se, 309CT, 316F, 316Se, 318, D319, 347Se, 348 |
| | | 4.3 | Allegheny | All necessary forms | Types 403, 405, 410, 414, 416, 420, 430, 431, 440A, 440B, 440C, 446, 416Se, 420F, 420Se, 430Se, 430Ti, 440F, 440Se, 442 |
| | | 4.5 | AM-350, AM-355 | All necessary forms | |
| | | 21 | [ Allegheny Zirconium, Zircaloy 2 and 3 ] | All necessary forms | Commercial or reactor grades |
| 4 | Allied Chemical Corp., Plastics & Coal Chemicals Div. New York, N. Y. | 26.6 | Plaskon | Molding powder | |
| | | 26.9, 26.8 | Plaskon | Liquid resin | |
| 5 | Allied Chemical Corp., Semet-Solvay Petrochemical Div. New York, N. Y. | 26.10 | A-C | Cubes, pellets | High-density polyethylene |
| 6 | Alloy Steel Products Co. Linden, N. J. | 5.1.1, 5.1.2, 13.1, 13.2, 13.3, 13.5, 13.6, 13.7 | Aloyco | Castings | Pressure castings for valves, jacketed fittings |
| 7 | Alpha Plastics, Inc. Livingston, N. J. | 26.12.1 | Alpha | Pipe, tube, bars, shapes | |

| CODE | COMPANY | MATERIAL | TRADE NAME | FORMS | REMARKS |
|---|---|---|---|---|---|
| 8 | **Aluminum Co. of America Pittsburgh, Pa.** | 6.1—6.6 | | Sheet, plate, wire, rod, bar, extrusions | Also 7000 series. And rolled shapes in 2000 and 6000 series; drawn tubes in 2000, 3000, 5000, 6000 series; rivets in all series but 3000; forgings in all series but 5000 |
| | | 12 | | Castings | |
| 9 | **American Brake Shoe Co., Electro-Alloys Div. Elyria, Ohio** | 5.1.1, 5.1.2 | Chemalloy | | CF8, CF8M, ASTM 296A |
| | | 5.2.2, 5.2.3 | Thermalloy | | Thermalloy 47 (26Cr-20Ni), Thermalloy 34 (28Cr-6Ni), Thermalloy 40 (28Cr-12Ni), Thermalloy 48 (30Cr-20Ni) New material Supertherm 26Cr-35Ni with cobalt and tungsten |
| 10 | **American Brake Shoe Co., National Bearing Div. Pittsburgh, Pa.** | 10.1 | NBD Alloys | Centrifugal and static castings, rough or machined | High-conductivity copper parts |
| | | 10.2, 10.3, 10.5 | NBD Alloys | Centrifugal and static castings, rough or machined | All nickel, copper and aluminum bronzes |
| | | 10.7 | NBD Alloys | Centrifugal and static castings, rough or machined | High-lead bronzes |
| | | 22 | Superston | Centrifugal and static castings, rough or machined | Cu-Al-Mn corrosion-resistant high-strength alloy |
| 11 | **American Cyanamid Co. New York, N. Y.** | 26.7 | Cymel | Molding compounds | |
| | | 26.8 | Laminac | Resins | Special polyesters are available for resisting corrosion |
| 12 | **American Hard Rubber Co. Butler, N. J.** | 3.3 | | Pipe | Rubber lined |
| | | 26.2, 26.10, 27.2.1, 27.2.3 | | Tubing, sheets, molding | |
| 13 | **American Manganese Bronze Co. Philadelphia, Pa.** | 10.5 | Resistac | Castings and forgings | Aluminum bronze |
| | | 10.7 | Hy-ten-el | Castings and forgings | High-strength manganese bronze |
| 14 | **American Smelting & Refining Co. New York, N. Y.** | 5.1.1, 5.1.2 | | Ingot | |
| | | 6.1—6.5 | | Casting ingot | |
| | | 6.6 | Tengaloy | Casting ingot | High-strength aluminum alloy |
| | | 10.1, 10.2 | Asarcon-Ni-Vee | Rods and bars only | Continuous cast rods, tubes and shapes also available |
| | | 10.3 | Asarcon | Rods and bars only | Continuous cast rods, tubes and shapes also available |
| | | 10.4, 10.5 | Herculoy | Ingot only | |
| | | 11 | Asarco | Pipe, sheet, pig, coil, wire, etc. | |
| | | 13.2, 13.4, 20 | | Ingot | |
| | | 23 | Lake Fibre | Fiber only | Chrysotile asbestos in all standard grades |
| 15 | **Amercoat Corp. South Gate, Calif.** | 26.3 | Bondstrand | Pipe and fittings | Fiberglass reinforced epoxy resin |
| 16 | **Ampco Metal, Inc. Milwaukee, Wisc.** | 10.7 | Ampcoloy | Rod, sand and centrifugal castings | Cu 97, Be 2.05, Co 0.35, others 0.60 max. (#83-20); Cu 94.5, Be 2.5, Ni 1.5, Co 1.5, others 1.0 (#84-20) |
| | | 10.2 | Ampcoloy | Rod, sand and centrifugal castings, forged | Cu 88.9, Al 10.9, Fe 3.5, Ni 5.5, Mg 1.5, others 0.6 (extr, #45); Cu 73.5, Al 12, Fe 0.6, Ni 6, Mg 0.2, others 0.5 (cast #46) |
| | | 10.3 | Ampcoloy | Sand and centrifugal castings | 4 alloys with 5.5–11 Sn, (#71,72,74,79) |
| | | 10.5 | Ampco metal | Rods, rolled, sand and centrifugal, forged | High Fe-Al, high strength (#8, 12, 15, 16, 18, 20, 21, 24) |
| | | | Ampcoloy | Rods, sand and centrifugal, forged | Commercial Al bronzes (#A2, A3, E1, 40, 44, 45, 46) |
| | | 10.7 | Ampcoloy | Rods, sand and centrifugal castings | 4 alloys up to 5.0 Mg, (#62, 64, 66, 666) |
| | | 13.2 | Ampcoloy | Sand and centrifugal castings | |
| 17 | **Anaconda American Brass Co. Waterbury, Conn.** | 10.1, 10.2, 10.6 | | Sheet, strip, plate, wire, rod, tube, extruded shapes, die-pressed forgings | |
| | | 10.4 | Everdur | Sheet, rod, wire, plate, tube, bar, extruded shapes, die-pressed forgings | |
| | | 10.5 | Tempaloy and Avialite | Sheet, strip, plate, rod, bar, tube, die-pressed forgings | |
| | | 21 | | Rod, rectangles, strip, wire | |
| 18 | **Armco Steel Corp. Middletown, Ohio** | 4.1—4.3, 4.5 | | Bars, wire, sheets, plate | |

| CODE | COMPANY | MATERIAL | TRADE NAME | FORMS | REMARKS |
|---|---|---|---|---|---|
| 19 | Atlas Mineral Products Co.<br>Mertztown, Pa. | 26.12.1 | Ampcoflex | Rigid plastic | Pipe, fittings |
| | | | Pee Vee Cee | Rigid plastic | Pipe, fittings |
| | | 27.1 | | Sheet form for tank linings | |
| | | 27.2.4 | Fairprene | Sheet form for tank linings | |
| 20 | Atlas Powder Co.<br>Wilmington, Del. | 26.8 | Atlac 382 | Liquid and powder | Patented bisphenol polyester for extreme corrosion resistance |
| 21 | Automotive Rubber Co., Inc.<br>Detroit, Mich. | 27.1, 27.2.2, 27.2.4, 27.2.7, 27.3 | | Tank linings and roll coverings | Also neoprene |
| 22 | Babcock & Wilcox Co.,<br>Alloy Div.<br>New York, N.Y. | 2, 4.2.1, 4.2.2, 4.2.3, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.2.3, 13.2, 13.3 | Hollow Forging | Large diam. heavy-wall pipe | |
| 23 | Babcock & Wilcox Co.,<br>Boiler Div.<br>New York, N.Y. | 2 | | Custom castings | Alloy steels |
| 24 | Babcock & Wilcox Co.,<br>Refractories Div.<br>New York, N.Y. | 25.4 | | Castables, brick | |
| 25 | Babcock & Wilcox Co.,<br>Tubular Products Div.<br>Beaver Falls, Pa. | 2 | B & W | Tubing, extrusions, welding fittings | Carbon and alloy steels (Ni, Mo) |
| | | 4.2—4.3 | B & W Croloy | Tubing, extrusions, welding fittings | |
| | | 4.5 | | Tubing, extrusions | |
| 26 | J. T. Baker Chemical Co.<br>Phillipsburg, N.J. | 26.1 | Barick II | Pellets and powder | Extrusion, injection-molding grades |
| 27 | Bart Laboratories & Design, Inc.<br>Newark, N. J. | 3.3 | Lectro-Clad | Sheet, plate, tube, pipe, fittings, flanges | Nickel-clad, low-carbon steel for corrosion, erosion and product-contamination prevention |
| 28 | The Belden Brick Co.<br>Canton, Ohio | 25.5 | Belden | Brick and tile | Acidproof |
| 29 | The Belmont Packing & Rubber Co.<br>Philadelphia, Pa. | 23 | Crisscross | Coil, sheet | |
| | | 26.4 | | Sheet | Teflon |
| | | 26.6 | Crisscross | Coil, sheet | |
| | | 26.13, 27.1, 27.2.2, 27.2.4, 27.2.6 | | | |
| 30 | Belmont Smelting & Refining Works, Inc.<br>Brooklyn, N. Y. | 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.2.3, 9 | Belmont | Slab | |
| | | 6.1 | Belmont | Slab, ingot, waffle | |
| | | 6.2, 6.3, 6.4, 6.5 | Belmont | Ingot | |
| | | 7 | Belmont | Ingot, cut bar, slab | |
| | | 10.1 | Belmont | Slab, ingot, shot, powder | |
| | | 10.2, 10.3, 10.4, 10.5, 12, 13.2—13.6, 14, 15, 16, 19, 21, 22 | Belmont | Slab, ingot | |
| | | 11 | Belmont | Slab, ingot, shot, powder, sheet, wire | |
| | | 13.1 | Belmont | Slab, ingot, shot | |
| | | 17 | Belmont | Slab, ingot, shot, wire | |
| | | 20 | Belmont | Slab, ingot, shot, wire, anodes, sheet | |
| 31 | Beryllium Corp.<br>Reading, Pa. | 7 | Berylco | Rod, bar, strip, wire, castings, extrusions, billet | |
| 32 | Bethlehem Foundry & Machine Co.<br>Bethlehem, Pa. | 1 | | Castings | Ductile and gray cast iron |
| 33 | Bethlehem Steel Co.<br>Bethlehem, Pa. | 2 | | All forms (billets, rods, bars, sheets) | Carbon steels (wrought or cast) |
| | | 4.3, 4.4 | | Billets and bars | Types 410, 440A, 440B, 440C 501, 502 |
| | | 2 | | Wrought or cast | Alloy steels (moly, nickel, chrome, chrome-moly, chrome-nickel, other) |
| 34 | J. Bishop & Co.<br>Platinum Works<br>Malvern, Pa. | 4.2, 4.2.1, 4.2.2, 4.2.3, 4.3, 4.5, 4.6, 8, 13.1, 13.2, 13.6, 15, 16 | | Tubing up to 1in. O.D. | |
| | | 14 | | Tubing, plate, sheet, rod, wire, foil, gauze and other forms | |
| | | 21 | | Tubing | |
| 35 | Blaw-Knox Co.,<br>National Alloy Div.<br>Blawnox, Pa. | 2 | | Cast form | |
| | | 5.1.1—5.2.4 | | Cast form (all grades) | |

| CODE | COMPANY | MATERIAL | TRADE NAME | FORMS | REMARKS |
|---|---|---|---|---|---|
| 36 | Borg-Warner Corp., Ingersoll Steel Div. New Castle, Ind. | 2, 4.2.3 | Temcross | Sheets and plates | |
| | | 4.2, 4.2.1, 4.2.2, 4.2.3 | Temcross | Sheets and plates | Also 2 ply—trade name IngAclad |
| | | 4.3, 4.4 | Temcross | Sheets and plates | Types 410, 420, 430, 442, 446, 501, 502 |
| 37 | Borg-Warner Corp., Marbon Chemical Div. Washington, W. Va. | 26.2 | Cycolac | Powder and pellets | For extruding, calendering and injection molding |
| 38 | Bridgeport Brass Co. Bridgeport, Conn. | 3.2 | Duplex | Tube | Nonferrous |
| | | 3.3 | Clad Metals | Sheet, circles for tubesheets | Nonferrous—also stainless combined with nonferrous |
| | | 6.2, 6.3, 6.5 | | Rod and sheet | |
| | | 8 | | Tube extrusions | Pure Cb |
| | | 10.6 | | Rod, sheet, tube, wire | Brasses, bronzes, modified brasses and bronzes, Admiralty, Muntz |
| | | 10.1 | | Rod, sheet, tube, wire | Electrolytic tough-pitch; oxygen-free high-conductivity; arsenical copper, sulphur copper; zirconium copper; cadmium copper; chromium copper; tellurium copper |
| | | 10.2 | | Tube, sheet, wire | 95/5; 90/10; 80/20; 70/30 (annealed or drawn and stress relieved); copper/nickel/silicon (Nironze) |
| | | 10.3 | | Rod, sheet, tube, wire | Phosphor bronzes A, B, C & E; contact bronze; tin bronze |
| | | 10.4 | Duronze | Rod, tube | Copper silicon 609 (Duronze); copper-silicon-iron 632 (Duronze) |
| | | 10.5 | | Tube | Aluminum bronze; aluminum-silicon bronze; aluminum brass |
| | | 15, 16, 21 | | Tube extrusions | |
| 39 | Broadway Rubber Corp., Acme-Fisher Div. Louisville, Ky. | 26.12.1 | Koroseal | Sheet, | Lined equipment |
| | | 27.1, 27.2.1 | Laybond | Sheet | Lined equipment (tanks, pipe, fittings, valves) |
| 40 | The Brush Beryllium Co. Cleveland, Ohio | 4.2, 4.5 | Pennrold | Precision strip | Types 301, 302, 17-7 PH |
| | | 7 | QMV | Vacuum-cast ingot, chip and powder, block, hot-pressed shapes, machined components, hot-rolled sheet, extrusions and fabricated shapes | |
| | | | Pennrold (for strip products only) | Casting and master-alloy ingot, continuous-cast billet, bar, plate and precision strip. | Be copper |
| | | 10.3 | Pennrold | Precision strip | Phosphor bronze, Grade A, C |
| | | 13.7 | Pennrold | Precision strip | Nickel silver, 12%, 18% |
| | | 25.5 | UOX | Powder, fabricated shapes | Beryllium oxide |
| 41 | The Bunker Hill Co. San Francisco, Calif. | 11 | Bunker Hill | Sheet, tube, wire, castings | Chemical lead, antimonial lead, tellurium lead |
| | | 20 | Bunker Hill | Anodes, castings | |
| 42 | A. M. Byers Co. Pittsburgh, Pa. | 1 | | | Wrought iron |
| | | 26.12.1 | | Pipe | |
| 43 | Calumet & Hecla, Inc., Wolverine Tube Div. Allen Park, Mich. | 6.1, 6.2, 6.5, 10.6, 16, 21 | | Tubing, rod | |
| 44 | Cannon-Muskegon Corp. Muskegon, Mich. | 2, 4.2.1, 4.2.2, 4.2.3, 5.2.2, 5.2.3, 9, 13.2, 13.3 | Master Met | Shot and ingots for remelt | |
| | | 4.2, 4.3, 4.5 | Master Met | Shot and ingots for remelt | Types 302, 310, 321, 330; 403, 405, 410, 416, 420, 430, 431, 440; AM 355, 17-4PH |
| | | 13.7 | Ultramet | Sheet, wire, bar | Vacuum melted alloys—Rene 41, Waspalloy |
| 45 | The Carbone Corp. Boonton, N. J. | 24 | Graphiton, Carbolube, Carbolon | Rod, plate, bar | |
| 46 | The Carborundum Co. Niagara Falls, N. Y. | 21 | | All mill forms, castings, powder | |
| | | 22 | | All mill forms, powder | Hafnium |
| | | 25.4 | KT, GRB | | Silicon carbide |
| | | 25.5 | Boron Nitride, Fused Magnesium Oxide | | |

| CODE | COMPANY | MATERIAL | TRADE NAME | FORMS | REMARKS |
|---|---|---|---|---|---|
| 47 | The Carborundum Co., Refractories Div. Perth Amboy, N. J. | 25.4 | Carbofrax<br>Alfrax<br>Mullfrax<br>Refrax<br>Fiberfrax | Brick blocks, plates, tubes, and other formed shapes | Ceramic-bonded silicon carbide<br>Ceramic-bonded fused alumina (both granular and bubbles)<br>Ceramic-bonded electric-furnace mullite<br>Silicon-nitride-bonded silicon carbide<br>Ceramic fiber |
| 48 | The Carborundum Metals Co. Akron, N. Y. | 21 | Zircaloy | Tube, wire, rod, bar, strip, sheet, forgings, ingot, powder | Zircaloy-2, Zircaloy-4, reactor grade, commercial grade, ATR, AJR, plus special alloys |
| 49 | Carlon Products Corp. Cleveland, Ohio | 26.12.1, 26.6, 26.10 | | Pipe, tubing | |
| 50 | G. O. Carlson, Inc. Thorndale, Pa. | 4.2, 4.2.1, 4.2.2, 4.2.3 | | Plates, heads, forgings, bars, sheets (#1 finish) | Types 302, 304, 304L, 305, 309, 309S, 309SCb, 310, 310Cb, 314, 316, 316L, 317, 317L, D319, D319L, 321, 347, 348, Cut-to-shape items |
| | | 4.3 | | Plates, heads, forgings, bars, sheets (#1 finish) | Types 405, 410, 430, Cut-to-shape items |
| | | 4.4 | | Plates, heads, forgings, bars, sheets (#1 finish) | 502 (3½% Mo), Cut-to-shape items |
| | | 4.5 | | Plates, heads, forgings, bars, sheets (#1 finish) | 17-4PH, 17-7PH, PH 15-7Mo, Cut-to-shape items |
| 51 | The Carpenter Steel Co. Reading, Pa. | 4.2, 4.2.1, 4.2.2, 4.2.3, 4.3, 4.4, 4.6 | | Billets, bars, wire, strip, tubing, pipe | |
| 52 | The Carpenter Steel Co., Alloy Tube Div. Union, N. J. | 4.2, 4.2.1, 4.2.2, 4.2.3 | | Pipe and tube | |
| | | 4.3 | | Pipe and tube | Types 410, 442, 443 |
| | | 4.6 | Carpenter 20Cb | Pipe, tube, sheet, plate, bar, wire, forgings | |
| | | 4.7 | Carpenter 7Mo | Pipe and tube | |
| 53 | The Philip Carey Manufacturing Co. Cincinnati, Ohio | 23 | Carey-Canadian | Fibers and shorts | |
| | | 29 | Carey | Pipe and block forms | |
| 54 | Celanese Polymer Co. Newark, N. J. | 26.8 | | Liquid resins | Liquid and thixotropic |
| | | 26.10 | Fortiflex | Pellets | Linear, linear copolymers |
| 55 | Chase Brass & Copper Co. Waterbury, Conn. | 4.1, 4.2—4.2.3, 4.4 | | Bars, wire, plates, sheets, strip | Types 201, 202; 301, 302, 302B, 303, 303Se, 305, 308, 309, 309S, 309Cb, 310, 314, 317, 318, D319, 321, 348, 304, 304L, 316, 316L, 347, 347Se; 501, 502 |
| | | 4.3 | | Bars, wire, plates, sheets | Types 403, 405, 410, 414, 416, 416Se, 418Spl, 420, 420F, 420Se, 422, 430, 430F, 430Ti, 431, 440A, 440B, 440C, 440F, 440Se, 442, 446 |
| | | 4.5, 4.6 | | Strip, bar, wire | 17-7 PH, AL355 (strip only); 17-4 PH, AL350 |
| | | 6.1—6.6 | | Sheet, plate, bars, wire, tube | Alloys 1100, 1145, 1180; alloys 2011, 2014, 2017, 2018, 2024, 2117, 2218 (also extrusions); alloys 3003, 3004 (also pipe); alloys 5005, 5050, 5052, 5083, 5357, 5056, 5154, 5086 (except bars); alloys 6061, 6063 (also extrusions and pipe); alloys 7075, 7079 (also extrusions, no tube) |
| | | 10.1 | | Rod, bar, sheet, strip | Electrolytic tough-pitch copper |
| | | | | Rod, bar, sheet, strip, tube | High-phosphorus deoxidized copper |
| | | | | Tube | Arsenical copper |
| | | | | Rod, bar, sheet, strip, tube | Oxygen-free high-conductivity copper |
| | | 10.2 | | Rod, sheet, strip, tube | Cupro-nickel, 10% |
| | | | | Rod, strip, tube | Cupro-nickel, 30% |
| | | 10.3 | | Rod | 444 Bronze |
| | | | | Rod, wire | Phosphor bronze, 5% |
| | | | | Wire | Phosphor bronze, 8% |
| | | | | Tube, wire | Inhibited admiralty |
| | | 10.4 | Silnic | Sheet, strip | High-silicon bronze |
| | | | | Rod, wire | Low-silicon bronze |
| | | | | Rod, wire, strip | Silnic bronze |

# DIRECTORY OF MANUFACTURERS

| CODE | COMPANY | MATERIAL | TRADE NAME | FORMS | REMARKS |
|---|---|---|---|---|---|
| 55 | Chase Brass & Copper Co. Waterbury, Conn. (Cont'd. from p. 199) | 10.5, 10.6, 10.7 | | Rod<br>Tube | Aluminum-silicon bronze<br>Inhibited aluminum brass. Also, red brass, 85% (rod, bar, wire, sheet, strip, tube) |
| | | 21 | | Tube | Sizes from 2 in. to 5 in. |
| | | 22 | | Powder, strip, disks and wire | High-purity rhenium, rhenium-molybdenum alloys and rhenium-tungsten alloys |
| 56 | Chemical & Power Products, Inc. New York, N. Y. | 26.4 | | Rod, bars, sheets, powder, rings, cylinders, tube, tape | Teflon, Kel-F—all grades and types |
| 57 | Chicago Bridge & Iron Co. Chicago, Ill. | 3.2, 3.3 | | Plates, sheets | Ni alloys-, stainless-, Ti-clad steel |
| 58 | Chicago Gasket Co. Chicago, Ill. | 23 | | Sheet packing and gasket material | Blue african felt, compressed |
| | | 26.4 | | Rod, sheet, tube, tape, sleeves | Molded, machined, and cut parts of all sizes and shapes |
| 59 | Ciba Products Corp. Fair Lawn, N. J. | 26.3 | | Liquid and solid resins | |
| 60 | Climax Molybdenum Co. New York, N. Y. | 10.1, 10.7 | Amco, Amzirc, Amsulf, Amphos | Rods, bars, ingots, powder, shapes | Cu and Cu-Zr, Cu-S, Cu-P alloys |
| | | 14 | | | Silver, gold, germanium |
| | | 17, 20 | Amco | Rods, bars, ingots, powders, slab | |
| | | 22 | Climelt | Rods, bars, sheet | Molybdenum alloys |
| 61 | James B. Clow & Sons, Inc. Chicago, Ill. | 1 | | Pipe, fittings, 3 in. to 24 in. | Gray cast iron and ductile iron |
| 62 | Colonial Plastics Mfg. Co. Cleveland, Ohio | 26.12.1 | Van-Cor | Pipe, fittings, valves, sheet, bar and fabrications | All available in either high or normal impact |
| 63 | The Colorado Fuel and Iron Corp., Wickwire Spencer Steel Div. Claymont, Del. | 2 | | Plates | All ASTM grades, carbon and alloy steels |
| | | 3.2 | | Stainless-clad plates | All ASTM & AISI grades |
| 64 | Columbia-National Corp. (Sub. of Columbia-Southern Chemical Corp.) Pittsburgh, Pa. | 21 | | Sponge | |
| 65 | Connecticut Hard Rubber Co. New Haven, Conn. | 26.4 | Cohrlastic | Sheet | Also fuel-resistant Teflon pressure-sensitive tape |
| | | 27.3 | Cohrlastic | Sheets, sponge rod, tubing, sponge sheets, fluorosilicone sponge sheet | Also Viton |
| | | 27.2.6 | Cohrlastic | Sheets, sponge rod, tubing, sponge sheets | |
| 66 | Cooper Alloy Corp. Hillsdale, N. J. | 2, 4.5<br>5.1.1—5.2.4 | | Castings | |
| 67 | Coors Porcelain Co. Golden, Colo. | 25.3 | Coor USA | Various forms | |
| | | 25.5 | | Rods, tubes, insulators, custom parts | High aluminas and beryllias |
| 68 | Copperweld Steel Co., Ohio Seamless Tube Div. Shelby, Ohio | 2 | Ohio | Electric-welded steel tubing<br>Seamless steel tubing | MT-1010 to 1025 (welded)<br>Full carbon range (seamless) |
| | Superior Steel Div. Pittsburgh, Pa. | 2 | Ohio | Seamless steel tubing | To AISI 9850, alloy steels |
| | | 4.1—4.3 | | Sheet, strip | |
| 69 | Corning Glass Works Corning, N. Y. | 25.1 | Pyrex | Rod, tubing, pressed, blown, cast | Borosilicate |
| | | 25.2 | Corning | Custom-made shapes | |
| | | 25.5 | Pyroceram | Rod, tubing, pressed, blown | Glass-ceramic |
| 70 | Crane Packing Co. Morton Grove, Ill. | 26.4 | | Sheet, rod, tubing, tape, pellets | TFE, FEP |
| 71 | Crucible Steel Co. of America Pittsburgh, Pa. | 1 | | Pigs and bars | |
| | | 2 | | All forms but tubing | Carbon and alloy steels |
| | | 4.1—4.6, 16 | | All forms | |
| | | 5.2.1—5.2.4 | | Cast to specifications | |
| 72 | Damascus Tube Co. Greenville, Pa. | 4.1—4.2.3, 4.5, 4.6 | Damascus Flo-Rol | Tubing and pipe | |
| | | 15, 16, 21 | | Tubing and pipe, bimetal and single | |
| 73 | Diamond Alkali Co. Cleveland, Ohio | 26.12.1 | Diamond PVC | Powder | Several molecular weights available. Suspension and paste-resin products as well as vinyl-acetate vinyl-chloride copolymer |

| CODE | COMPANY | MATERIAL | TRADE NAME | FORMS | REMARKS |
|---|---|---|---|---|---|
| 74 | Dow Chemical Co. Midland, Mich. | 12 | | Pig, ingot | Mg metal |
| | | 26.1 | | Resin | Acrylates of methyl, ethyl, butyl |
| | | 26.3 | | Liquids and solids | Resins, hardners |
| | | 26.10 | | Resin, foam, film | |
| | | 26.11, 26.12.1 | | Resin | |
| | | 26.12.2 | Saran | Sheets, rods, cylinders, blocks, disks, tubes, resin | Also lined iron pipe |
| | | | Saraloy 400 | Sheets | Flexible flashing |
| | | 27.2.1 | | Latexes | |
| 75 | Dow Chemical Co., Metal Products Co. Div. Midland, Mich. | 6.1—6.6 | | Sheet, plate, extrusions, rod, bars, tube, pipe | Alloys 1100, 2024, 3003 (1.2Mn), 3004 (1.2Mn, 1 Mg), 5005, 5050, 5052, 5154, 6061, 6063 |
| | | 12 | | Sheet, plate, extrusions, rod, bar, tube, pipe | Mg alloys |
| 76 | Dow Corning Corp. Midland, Mich. | | | Solution | 59% silicone-resin solution, laminating resins for components serviceable at temperatures around 500 F. |
| | | 26.13 | | Dry resin | Mineral filled and glass-fiber reinforced. Molding compound for compression or transfer molding of structural and electrical components serviceable at temperatures to 900 F. |
| | | | | Powders | Foamed structures for high-temperature applications |
| | | 27.2.6 | Silastic | Fully-compounded silicone-rubber stocks and pastes | Gaskets, seals, O-rings, ducts, electrical and other applications for temperatures from 130 to 500F. |
| 77 | E. I. du Pont de Nemours & Co. Wilmington, Del. | 8 | | Rods, bars, sheets | Cb, Cb-1 Zr, Cb-10 Ti-10 Mo (D31) |
| | | 16 | | Titanium sponge | Titanium sponge for melting into titanium metal and titanium-base alloys. Titanium pellets and briquettes for addition agents in stainless steel and super alloys |
| | | 26.1 | Lucite | Resin and syrup | For component parts, etc. |
| | | 26.4 | Teflon | Resin | Tetrafluorethylene & fluorinated ethylene propylene used as lining, coating, molded components |
| | | 26.6 | Zytel | Resin | Molded components |
| | | 26.10 | Alathon | Resin | For linings, pipe |
| | | 26.14 | Delrin | Resin | For pipe, molded components |
| | | 27.2.3 | | Chips, latex | |
| | | 27.2.7 | Hypalon | Chips | |
| | | 27.3 | Viton | Sheets | Fluoroelastomer |
| | | | Adiprene | Liquid | Urethane rubber |
| 78 | The Duraloy Co. Scottdale, Pa. | 5.1.1, 5.1.2, 5.2.1-5.2.3 | Duraloy | Static, shell & centrifugal castings | |
| 79 | The Duriron Co., Inc. Dayton, Ohio | 1 | Duriron | Castings | Cast iron—ASTM A48-56, Class 25; Ductile iron—ASTM A395-56T; Duriron—14.5% Si, 0.85% C, 0.65% Mn, remainder Fe; Durichlor—14.5% Si, 0.85% C, 0.65% Mn, 3.0% Mo, remainder Fe |
| | | | Durichlor | | |
| | | 2 | | Castings | ASTM A27-58, Grade 70-36 |
| | | 5.1.1 | Duco D12 | Castings | Type CA-15 |
| | | | Duco D12H | Castings | Type CA-40 |
| | | 5.1.2 | Duco 18-8 | Castings | ACI Type CF-8 |
| | | | Duco 18-8H | Castings | ACI Type CF-20 |
| | | | Duco 18-8C | Castings | ACI Type CF-8C |
| | | | Duco 18-8L | Castings | ACI Type CF-3 |
| | | | Duco 18-8M | Castings | ACI Type CF-8M |
| | | | Duco 18-8MC | Castings | ACI Type CF-10MC |
| | | | Duco 18-8ML | Castings | ACI Type CF-3M |
| | | | Duco D-6 | Castings | ACI Type CM-25 |
| | | | Duco 25-20 | Castings | ACI Type CK-20 |
| | | | Duco 25-12H | Castings | ACI Type CH-20 |
| | | 5.1.3 | Duco 25-5L | Castings | Type CD-4M Cu |
| | | | Durimet 20 | Castings | Type CN-7M |
| | | 5.2.3 | Duco 25-20H | Castings | ACI Type HK |
| | | | Duco 20-25H | Castings | ACI Type HN |
| | | | Duco 35-15H | Castings | ACI Type HT |
| | | 13.1 | | Castings | 96% Ni |
| | | 13.2 | Monel | Castings | 65% Ni, 30% Cu |
| | | 13.3 | Duco D-10 | Castings | 65% Ni, 23% Cr, 2% Mo, 3.5% Cu |
| | | 13.5 | Chlorimet 2 | Castings | 62% Ni, 32% Mo. |
| | | 13.6 | Inconel | Castings | 78% Ni, 15% Cr, 5% Fe |
| | | 13.7 | Chlorimet 3 | Castings | 60% Ni, 18% Cr, 18% Mo |
| | | | Chlorimet 4 | Castings | 85% Ni, 10% Si, 3.5% Cu |
| | | 26.3 | Durcon 2, 3, 4, & 5 | Castings | |

| CODE | COMPANY | MATERIAL | TRADE NAME | FORMS | REMARKS |
|---|---|---|---|---|---|
| 80 | du Verre, Inc.<br>Arcade, N. Y. | 26.3 | du Verre Epoxy | Fiberglass reinforced custom fabricated into duct, pipe, tanks or other special shapes | The 3 basic types of resin are used depending upon conditions of temperature and chemical service. |
| | | 26.5 | du Verre 101 | | |
| | | 26.8 | du Verre 11, 22, 77 | | |
| 81 | Eastern Stainless Steel Corp.<br>Baltimore, Md. | 4.2—4.2.3 | ES | Sheets, plates, strip, floor plates, coils | |
| 82 | Eastman Chemical Products, Inc.<br>Kingsport, Tenn. | 26.10 | Tenite | Pellets | |
| | | 26.14 | Tenite | Pellets | Cellulose acetate-butyrate, and acetate-propionate |
| 83 | Electro Chemical Eng. & Mfg. Co.<br>Emmaus, Pa. | 25.4 | Acid Brick | | Red shale, fire clay and carbon |
| | | 26.4 | Elgard | Sheet | |
| | | 26.12.1 | Duroware-PVC | Sheet | Type I, Type II |
| | | 27.2.4 | Buta-Bond | Sheet | Tank lining grade |
| 84 | Empire Steel Castings, Inc.<br>Reading, Pa. | 2, 4.5, 13.1 | SO-Cast | Sand and shell castings | |
| | | 5.1.1, 5.1.2, 5.2.2, 5.2.3 | SO-Cast | Sand and shell castings | ACI Types |
| 85 | Enjay Chemical Co.<br>A Div. of Humble Oil & Refining Co.<br>New York, N. Y. | 26.11 | Escon | Pellets | Escon 103, 104, 105, 113, 114, 115 |
| | | 27.2.4 | Enjay Butyl | 50 lb. bales | E.B. 035, 150, 218, 165, 268 365 |
| | | 27.3 | Vistanex | 50 lb. bales | Vistanex L-80, L-100, L-120, L-140 |
| 86 | Escambia Chemical Corp.<br>New York, N. Y. | 26.12.1 | | Pellets, powder | |
| 87 | Esco Corporation<br>Portland, Ore. | 5.1.1, 5.1.2, 5.1.3, 5.2.2, 5.2.3 | Esco | Centrifugal, static and shell-mold castings | T-501, HA, CA-15; 17-4PH, CD4-MCu, CE-30, 304L, CF-8, 303, 305, CF-3M, CF-8M, 316, CF-8C; CN-7MCu, Ni-Resist (Type I, II, III); HC; HF, HH, HK, Multimet N-155, HT |
| | | 13.1, 13.2, 13.3, 13.5 | Esco | Castings | Cast Ni; Cast Monel; Inconel, HW, HT, Hastelloy B, C |
| 88 | Falls Industries, Inc.<br>Solon, Ohio | 24 | Impervite | Sheets, plates, rods, bars, tubes | |
| 89 | Fansteel Metallurgical Corp.<br>North Chicago, Ill. | 8, 15 | Fansteel | Powder, sheet, rod, wire, tubing and fabrications | |
| | | 18 | Fansteel | Powder, sheet, rod and fabrications | |
| | | 22 | Fansteel | Powder, sheet, rod, wire, tubing and fabrications | Molybdenum |
| 90 | Firestone Plastics Co.<br>Pottstown, Pa.<br>(Div. Firestone Tire & Rubber) | 26.4 | Exon 461 | Powder | Fluorochloroethylene copolymer |
| | | 26.6 | Nylon 200 | Pellets | Unstabilized and heat stabilized (Type 6) |
| | | 26.12.1 | Exon | Powder, pellets, latex | Dry process, dispersion, solution, latex, extrusion and molding compounds |
| | | 27.2.1 | Butaprene | Latex | High-styrene type for various applications |
| 91 | The Firestone Tire & Rubber Co.<br>Akron, Ohio | 26.1 | Butaprene XR-162 | Modified acrylic latex | |
| | | 26.6 | Firestone | Stabilized and unstabilized pellets; monofilament; continuous multifilament | |
| | | 26.10 | Firestone | Film sheets and monofilament | |
| | | 26.11 | Firestone | Pellets and some monofilament | |
| | | 27.1 | X2B and S-4 | Latex liquid | |
| | | 27.2.1 | FRS | Bales and liquid | |
| | | 27.3 | Diene | Baled in box | Synthetic from butadiene |
| 92 | Firth Sterling, Inc.<br>Pittsburgh, Pa. | 4.3 | | Billet, bar, rod | Type 440C |
| | | 5.1.2 | | Ingot, billet, bar, rod | A-286, Discaloy |
| | | 5.2.2 | | Ingot, billet, bar, rod | Greek Ascaloy |
| | | 5.2.3 | | Ingot, billet, bar, rod | A-286, Discaloy, V-57 |
| | | 13.3 | | Ingot, billet, bar, rod | 16-25-6, M-252, Waspaloy, Udimet 500, Inco 901 |
| | | 13.7 | | Ingot, billet, bar, rod | N-155, Udimet 500, Rene 41 (Ni-Cr-Co) |
| | | 18 | | Sintered W or WC parts | |
| | | 22 | | | Chromium carbides |
| 93 | Fluoro-Plastics, Inc.<br>Philadelphia, Pa. | 26.4 | | Sheet, rod, tubes, molded parts, machined parts | Teflon, Kel-F |
| 94 | Food Machinery & Chemical Corp.<br>New York, N. Y. | 26.3 | Oxiron | Liquid base resin | |
| | | 26.14 | Dapon | Powder | Diallyl phthalate prepolymer (resin) |

| CODE | COMPANY | MATERIAL | TRADE NAME | FORMS | REMARKS |
|---|---|---|---|---|---|
| 95 | Foote Mineral Co.<br>Philadelphia, Pa. | 9 | | Powder | |
| | | 13.1 | | Powder, briquettes | |
| | | 21 | | Bar, wire, sheet, powder | |
| 96 | Formica Corp.<br>Sub. of American Cyanamid Co.<br>Cincinnati, Ohio | 26.7, 26.9 | Formica | Sheets and 10 in. tiles | A high-pressure laminated plastic |
| | | 28 | Formica Flakeboard | Sheets | Made by heat compression of resin-saturated wood flakes |
| 97 | Furane Plastics, Inc.<br>Los Angeles, Calif. | 26.3 | Epocast, Epibond | Liquids, pastes, rods, sheets, powder, pellets | |
| | | 26.5 | Jetkote, Plaspreg | Liquids | |
| | | 26.14 | Uralane | Liquids and foaming liquids | Polyurethane coating resins and foams |
| | | 27.2.6 | | Medium viscosity liquid | Casting compound |
| 98 | Gates Engineering Co.<br>Wilmington, Del. | 27.1, 27.2.3, 27.2.7 | Gaco | Sheet stock | |
| 99 | Garlock, Inc.<br>Palmyra, N. Y. | 26.2, 26.12.1, 26.14 | | Special shapes | Including Delrin |
| | | 26.4 | | Rod, bar, cylinder, sheet, tape, tube, and special shapes | |
| | | 26.6 | | Rod, slab, film, sheet, tube, special shapes | |
| | | 26.10, 26.11 | | Special shapes, rod, tube | |
| | | 27.1, 27.2.1, 27.2.2, 27.2.3, 27.2.4, 27.2.6, 27.2.7, 27.3 | | Coil, strip, sheet, tube, special shapes | |
| 100 | General Alloys Co.<br>Boston, Mass. | 4.2—4.3, 4.5, 4.6, 5.1.1—5.2.3 | | Castings and fabrications | |
| 101 | General Ceramics Corp.,<br>Div. of Indiana General Corp.<br>Keasbey, N. J. | 25.3, 25.5 | | Complete line | Complete line high-temperature acid-resistant chemical ceramic pieces as large as 4 ft. diameter and 8 ft. high. Engineered equipment, components and standard products. Also alumina. |
| 102 | General Electric Co.,<br>Laminated Products Dept.<br>Coshocton, Ohio | 26.9 | | Sheets, tubes and rods | Grade TX-2013. Cotton canvas base. Excellent acid resistance. For water and steam valve disks |
| 103 | General Electric Co.,<br>Chemical Materials Dept.<br>Pittsfield, Mass. | 25.5 | G-E | Powder | Fused MgO, heating element and refractory grades |
| | | 26.9 | G-E | Molding powders | General and special purpose |
| | | 26.14 | Lexan | Powder and pellets | Polycarbonates; injection, casting, and extrusion grades |
| 104 | General Electric Co.,<br>Metallurgical Dept.<br>Detroit, Mich. | 18, 25.5, 13.3 | | Plate, bar, ingot | High-temperature alloys, including Rene 41 |
| 105 | General Electric Co.,<br>Plastics Dept.<br>Decatur, Ill. | 26.9, 26.6, 26.4, 27.2.6 | | Custom moldings | |
| 106 | General Electric Co.,<br>Silicone Products Dept.<br>Waterford, N. Y. | 26.13, 27.2.6 | | Compounds; gums and reinforced gums; and room-temperature vulcanizing liquid silicone rubber | |
| 107 | General Refractories Co.<br>Philadelphia, Pa. | 25.4 | | All shapes and sizes | Complete refractories service |
| | | 25.5 | | Mortars, plastics, castables | |
| 108 | General Tire & Rubber Co.,<br>Bolta Products Div.<br>Lawrence, Mass. | 26.2, 26.12.1 | Boltaron | Sheet, welding rod | ABS polymer blends, self extinguishing, normal- and high-impact polyvinyls |
| 109 | General Tire & Rubber Co.,<br>Chemical Div.<br>Akron, Ohio | 26.12.1 | Vygen | Powder | |
| | | 27.2.1 | Gentro, Gentro-Jet | Bales | |
| | | 27.3 | Genthane-s | Slabs | Polyurethane gum |
| 110 | Glascote Products, Inc.<br>Euclid, Ohio | 3.1, 3.3 | | Custom forms | |
| 111 | Goodall Rubber Co.<br>Trenton, N. J. | 27.1, 27.2.1, 27.2.2, 27.2.4 | | Sheets, tubular | |
| 112 | B. F. Goodrich Chemical Co.<br>Cleveland, Ohio | 26.2 | Abson | Resins, compounds | Acrylonitrile-butadiene-styrene |
| | | 26.12.1 | Geon | Resins, compounds, latex | |
| | | 26.14 | Estane | Resins, compounds | Thermoplastic polyurethane |
| | | 27.2.1 | Hycar | Sheets | |
| | | 27.2.2 | Hycar | Sheets, powder, crumb, liquid | |
| | | 27.2.4 | Hycar | Bale | Brominated |
| | | 27.3 | Hycar | Sheet | Polyacrylic |

| CODE | COMPANY | MATERIAL | TRADE NAME | FORMS | REMARKS |
|---|---|---|---|---|---|
| 113 | Goodyear Tire & Rubber Co.<br>Akron, Ohio | 27.1—27.2.4, 27.2.7 | Plioweld | Sheet | Plioweld is Goodyear trademark for all standard linings, regardless of polymer or composition. Special Trioweld contruction available for certain conditions such as continuous strip pickling lines |
| | | 26.12.1 | Pliovic | Resins | |
| 114 | Goslin-Birmingham Mfg. Co.<br>Birmingham, Ala. | 1, 2 | | Castings | Large special castings |
| 115 | W. R. Grace & Co.<br>New York, N. Y. | 26.12.2, 26.10 | | Sheet, film, pellets | |
| 116 | Graphite Specialties Corp.<br>Niagara Falls, N. Y. | 24 | Graph-I-Tite | Rods, tubes, bars, shapes | High density, impervious |
| 117 | Great Lakes Carbon Corp.<br>New York, N. Y. | 24 | HC, HPC, HLM, RI, BC, LFF, KFF, HL, HPL, TL, TPL | Graphite blocks, bars, slabs, machined shapes, nuclear graphite, tubes, carbon brick and blocks, plates and cements | HC—regular electrode-grade graphite<br>HPC—high-density electrode grade<br>HLM—high-density fine-grain mold-stock graphite<br>RI—high-purity and high-density nuclear grade<br>BC, LFF, KFF—Coke and anthracite base carbon products<br>HL—regular anode graphite<br>HPL—dense anode graphite<br>TL—oil-treated anode graphite<br>TPL—dense oil-treated anode graphite |
| 118 | Greene, Tweed & Co.<br>North Wales, Pa. | 23 | Palmetto | Sheet, gaskets, braided, twisted | Mechanical packings |
| | | 27.3 | Palmetto | Sheet, gaskets, molded | Mechanical packings |
| 119 | Grede Foundries, Inc.,<br>Special Products Div.<br>Milwaukee, Wisc. | 1, 2, 5.1.1—5.2.4 | | Castings | |
| 120 | Handy & Harman<br>New York, N. Y. | 14 | | Sheet, strip, wire, rods, powder | Fine silver and gold, sterling silver, karat golds, anodes, brazing alloys |
| 121 | Hanley Co.<br>Pittsburgh, Pa. | 25.3 | | Brick, tile | |
| 122 | Harbison-Walker Refractories Co.<br>Pittsburgh, Pa. | 25.4 | Woodland<br>Walsh XX | Fireclay bricks | Corundum, alumina, mullite, superduty fireclay, high, medium and low-duty fireclay, semi-silica fireclay, superduty and conventional silica, magnesite, magnesite-chrome, chrome, chrome-magnesite, forsterite, silicon carbide, zircon, acid-proof and insulating firebrick, block insulation. Included also are refractory fireclays, silica clays, ground silica quartzite, refractory castables and plastic firebrick, refractory mastic, chrome ore, furnace magnesite, dead-burned grain magnesite, high-temperature bonding mortars, ramming mixes, insulating materials |
| | | | Vega<br>Star | Silica bricks | |
| | | | Alamo<br>Varnon | Superduty fireclay bricks | |
| | | | H-W | Mullite | |
| | | | Harbide<br>Muicarb | Silicon carbide bricks | |
| 123 | The H. M. Harper Co.<br>Morton Grove, Ill. | 2 | | Extruded special bar-size shapes | C1010-1050, 4130, 4330, 4340, 5150, 8620 |
| | | 4.2 | | Extruded special bar-size shapes | Types 302, 303, 321 |
| | | 4.2.1, 4.2.2 | | Extruded special bar-size shapes, extruded standard angles | |
| | | 4.2.3, 4.6, 13.2, 13.3, 13.6 | | Extruded special bar-size shapes | |
| | | 4.3 | | Extruded special bar-size shapes | Types 410, 416, 430, 431 |
| | | 4.5 | | Extruded special bar-size shapes | 17-4PH, 17-7PH, 15-7-Mo |
| | | 16 | | Extruded special bar-size shapes | |
| 124 | Harvey Aluminum<br>Torrance, Calif. | 4.2, 4.3, 4.5 | Harvey | Extrusions | |
| | | 6.1—6.6 | Harvey | Pig, ingot, billet, rod, bar, pipe, tube, hollow sect- | All alloys |

| CODE | COMPANY | MATERIAL | TRADE NAME | FORMS | REMARKS |
|---|---|---|---|---|---|
| 124 | **Harvey Aluminum Torrance, Calif.** (Cont'd. from p. 204) | 6.1—6.6 | Harvey | ions, press forgings, forging stock, hand forgings, impact extrusions, rigid electrical conduit, structurals, special shapes, light and heavy press extrusions, | |
| | | 16 | Harvey | Ingot, billet, rings, forgings, rod, bar, extrusions, tubing, castings | All alloys |
| | | 21 | Harvey | Ingot, billet, slab, bar, plate, sheet, strip, foil, rod, wire, extrusions, tubing, forgings, castings | All alloys |
| 125 | **Haveg Industries, Inc. Wilmington, Del.** | 25.1 | Havelex | Sheet | Glass reinforced with mica |
| | | 26.1, 26.6, 26.7, 26.8 | Custom molded | | |
| | | 26.3 | | Cements and reinforced layups | |
| | | 26.4 | | Molded and fabricated parts | |
| | | 26.5 | Haveg 61 | Molded chemical-process equipment; sheet, rod, tube, pipe | |
| | | 26.9 | Haveg 41 | Custom-molded parts | |
| | | 27.2.6 | Haveg | Extrusions, sheets and die cuts | Also custom molded |
| 126 | **Heil Process Equipment Corp. Cleveland, Ohio** | 26.3, 26.8 | Rigidon | Sheets | |
| 127 | **Hercules Powder Co. Wilmington, Del.** | 26.10 | Hi-Fax | Pellets | |
| | | 26.11 | Pro-Fax | Pellets | |
| | | 29 | Penton | Pellets | Chlorinated polyether |
| 128 | **Hooker Chemical Corp. N. Tonawanda, N. Y.** | 26.4 | Flourolube | Liquid | |
| | | 26.5 | Dures | Liquid resin | |
| | | 26.8 | Hetron | Liquid resin | |
| | | 26.9 | Dures | Liquid and powdered resin | |
| 129 | **Illinois Clay Products Co. Joliet, Ill.** | 25.4 | Goose Lake | Brick | |
| 130 | **International Nickel Co. New York, N. Y.** | 13.1—13.7 | Monel, Inconel, Incoloy, Nionel | Sheets, plates, rods, bars, tubes, wire, forgings, castings | |
| 131 | **The Ironton Fire Brick Co. Ironton, Ohio** | 25.4 | Ironton | Fireclay, brick, refr. plastics, castables, mortars | Super, high, and intermediate duty, 60%, 70% and 80% $Al_2O_3$ brick and mixes |
| 132 | **Jessop Steel Co. Washington, Pa.** | 3.2 | | | Stainless clad, 300 and 400 series |
| | | 4.1 | | Bars, sheets, plates | |
| | | 4.2—4.3 | | Bars, sheets, plates, angles, billets | Types 303, 304, 316, 304L, 316L, 317, 317L, 321, 347, 405, 410, 416, 430, 440, A, B, C |
| | | 5.1.1—5.1.2, 5.2.2, 5.2.3 | | | Types 309, 309S, 330 |
| 133 | **Johns-Manville New York, N. Y.** | 23 | Transite | Sheets, boards | |
| | | 25.4 | Sil-O-Cel, Blanketa, Firecrete | Brick, refractory cements | |
| | | 26.4 | Chempac | Rods, bars, sheets, tapes | |
| | | 27.1 | Rub'R-Shim | Sheet, strip, roll form | |
| | | 27.3 | Tite-Pak, Tuff-Pak | Strip, roll form | |
| 134 | **Jones & Laughlin Steel Corp. Pittsburgh, Pa.** | 2 | | Sheets, rods, wires, bars | Carbon and alloy steels |
| | | 26.10, 3.3 | | PVC-lined pipe | Polyethylene bottles |
| 135 | **Jones & Laughlin Steel Corp., Stainless & Strip Div. Detroit, Mich.** | 2, 4.1—4.7 | | Bars, billets, wire, sheet, strips | Stainless, low-alloy steels |
| 136 | **Kaiser Aluminum and Chemical Corp. Oakland, Calif.** | 6.1—6.6 | | All mill forms | |
| 137 | **Kawecki Chemical Co. New York, N. Y.** | 8, 15 | | Powder, pellets, rod, bar, wire, sheet, foil | Pure metals |
| 138 | **Kearney Industries, Delanium Graphite Div. South Plainfield, N. J.** | 24 | Delanium | Blocks | Blocks for heat exchangers |
| 139 | **Keasbey & Mattison Co. Ambler, Pa.** | 23 | | Pipe, sheet | Asbestos-cement pressure, sewer, irrigation and air duct pipe; asbestos-cement decorative panels, structural sheets and shingles; industrial insulations, gasket and packing materials; asbestos textiles; sprayed "limpet" asbestos |

| CODE | COMPANY | MATERIAL | TRADE NAME | FORMS | REMARKS |
|---|---|---|---|---|---|
| 140 | Kennametal, Inc. Latrobe, Pa. | 8 | | Bars, sheets, rod, wire, foil | |
| | | 14 | | | |
| | | 15, 16 | | Bars, sheets, rod, wire, foil | |
| | | 18 | | Pressed shapes | |
| | | 25.5 | Kennametal and Kentanium | Rods, bars, tubes, disks, blocks, blanks, pressings, extrusions, preformed shapes | Sintered carbides of Ta and W: High hardness, high strength, high temperature and corrosion resistance |
| 141 | Knapp Mills, Inc. Long Island City, N. Y. | 11 | | Sheets, brick | |
| | | 3.3 | | Sheets | Lead bonded to steel, aluminum, copper, stainless |
| 142 | Maurice A. Knight Co. Akron, Ohio | 25.3 | Knight-Ware | | |
| | | 26.3 | Epiloc | Fabricated shapes | |
| | | 26.5 | Permanite | | |
| | | 26.8 | Resibond | | |
| | | 26.12.1 | Sealon | Sheets | For vessel lining |
| | | 27.3 | Pyroflex | | |
| 143 | Koppers Co., Inc. Chicago, Ill. | 26.10 | Durethene | Sheeting and thin-wall tubing | |
| 144 | Kraloy Plastic Pipe Co. Santa Ana, Calif. | 26.12.1 | Kraloy | Rigid tube | ½ to 12 in. |
| 145 | Kutztown Foundry and Machine Corp. Kutztown, Pa. | 1 | | Castings | C.I., high-strength C.I., Ni-Cr-Mo low-alloy C.I., ductile iron |
| | | 5.2.4 | | Castings | Ni-resist, ductile iron |
| 146 | La Favorite Rubber Mfg. Co. Hawthorne, N. J. | 27.1, 27.2.1, 27.2.2, 27.2.4 | | Sheet | |
| 147 | Lamtex Ind. Inc. Farmingdale, N. Y. | 26.3 | Hystran | Tubes, structures | Filament-wound epoxy |
| | | 26.8 | | Shapes, structures | Molded |
| | | 29 | Hystrom Tuff Tube | Tube, pipe, shapes | Reinforced plastic |
| 148 | Lapp Insulator Co., Inc. LeRoy, N. Y. | 25.3 | Lapp | Rods, tubes, custom shapes | |
| | | 25.5 | Lapp | | Alumina and high-strength porcelain to order |
| 149 | Latrobe Steel Co. Latrobe, Pa. | 2 | Various | Bars, billets, coils | Tool steels and high-strength steels |
| | | 4.2, 4.2.1, 4.2.2, 4.3 | Lescalloy | Bars, billets | |
| 150 | Lebanon Steel Foundry Lebanon, Pa. | 2 | Circle L | Castings | A27, A216, A352, A148; 4140, A148, A217, A352 |
| | | 5.1.1—5.2.4 | Circle L | Castings | CA-15, CF-8, CF-4, CF-16, 4-8M, CF20, CN-7M, CK-20, HH, HK, HT |
| | | 13.1—13.3 | Circle L | Castings | Nickel, Monel, Inconel |
| 151 | Libby-Owens-Ford Glass Co. Toledo, Ohio | 25.1 | Tuf-flex, Thermopane, Vitrolux | Stock sheet | |
| 152 | Libby-Owens-Ford Glass Fibers Co. Toledo, Ohio | 25.1 | | Fibers | For reinforced plastics |
| 153 | Link-Belt Co. Chicago, Ill. | 1 | Promal | Castings | Chains, buckets, castings |
| 154 | Logan Clay Products Co. Logan, Ohio | 25.5 | Logan | Vitrified clay pipe | |
| 155 | Lukens Steel Co. Coatesville, Pa. | 2 | Lukens | Plates | A201, A212, A285, A203 to A204, A353, A387, A302 |
| | | 3.2 | Lukens Clad | Plates | Nickel, Inconel, Monel, Nionel, A55 titanium, 300 and, 400 series of stainless, copper-nickel, Carpenter 20Cb |
| 156 | Luzerne Rubber Co. Trenton, N. J. | 26.12.1, 27.1, 27.2.1, 27.2.2 | Luzerne | Sheets, rod, tube, moldings, fabrications | |
| 157 | Mannesmann-Easton Plastic Products Co., Inc. Easton, Pa. | 26.12.1 | Easton | Pipe, tubing, bar and rod stock | I.P.S. sizes ¼in. through 8 in. Rigid unplasticised polyvinyl chloride |
| 158 | McDanel Refractory Porcelain Co. Beaver Falls, Pa. | 25.5 | | Tube, rods, special shapes. | Mullite and alumina |
| 159 | McLouth Steel Corp. Detroit, Mich. | 1 | McLouth | Pig iron | |
| | | 2 | McLouth | Sheet and strip | |
| | | 4.1 | McLouth | Sheet and strip | |
| | | 4.2, 4.2.1, 4.2.2, 4.2.3 | McLouth | Sheet and strip | Types 301, 302, 304L, 305, 309, 309S, 310, 310S, 316L, D319, 321, 348 |
| | | 4.3 | McLouth | Sheet and strip | Types 403, 405, 410, 430, 442, 446 |
| 160 | Michigan Chemical Corp. St. Louis, Mich. | 22 | | Ingots | Complete line high-purity metals of all rare earths |

| CODE | COMPANY | MATERIAL | TRADE NAME | FORMS | REMARKS |
|---|---|---|---|---|---|
| 161 | Michigan Seamless Tube Co.<br>South Lyon, Mich. | 2 | | Seamless tubing | |
| 162 | Midvale-Heppenstall Co.<br>Philadelphia, Pa. | 1, 2, 4.1, 4.2, 4.2.1, 4.2.2, 4.2.3, 4.3—4.7 | | Forgings, billets, ingots, (electric arc furnace, vacuum degassed and consumable-electrode melted (Midvac) | Materials are custom made to any specification within the categories listed |
| 163 | Midwest Alloys, Inc.<br>St. Louis, Mo. | 5.1.1, 5.1.2<br>5.1.3 | M-Loy<br>M-Loy | Cast<br>Cast | Nickel, Monel and Hastelloy types |
| | | 5.2.1—5.2.4 | M-Loy | Cast | Includes super alloys |
| 164 | Minnesota Mining and Mfg. Co.<br>St. Paul, Minn. | 26.3, 26.9<br>26.4 | Scotchply<br>Kel-F | Roll, sheets, powder<br>Powder, molded parts, rubber-like parts | |
| 165 | Modern Industrial Plastics Co.<br>Dayton, Ohio | 26.4 | | Custom molded, stock forms | Teflon, Kel-F |
| 166 | Monsanto Chemical Co.<br>St. Louis, Mo. | 26.8, 26.9, 26.12.1, 26.10 | | Resin powder | |
| 167 | Mueller Brass Co.<br>Port Huron, Mich. | 2<br>6.1, 6.3, 6.4, 6.5, 6.6<br>10.1, 10.2, 10.3, 10.5, 10.6, 10.7<br>26.12.1 | <br><br><br> | Powder compacts<br>Sheet, extrusions<br>Rod, bar, forgings<br>Pipe and tubing | |
| 168 | Naige Co.,<br>American Vulcathene Div.<br>Rochester, N. Y. | 26.10 | Vulcathene | Pellets, rods, sheet, pipe | Conventional, medium and high density |
| 169 | National Distillers and Chemical Corp.,<br>U.S. Industrial Chemicals Co. Div.<br>New York, N. Y. | 26.10 | Petrothene | Pellets, powder | Low and medium density |
| 170 | National Lead Co.<br>New York, N. Y. | 3.3, 11 | | Sheets, plates, tubular | |
| 171 | National Steel Corp.,<br>Weirton Steel Co. Div.<br>Weirton, W. Va. | 2 | | Sheets | |
| 172 | New Haven Copper Co.<br>Seymour, Conn. | 10.1 | | Plate, sheet, bar, strip, coils | |
| 173 | New England Brass Co.<br>Taunton, Mass. | 10.2<br>10.3<br>10.6 | <br><br>Nebaloy | Sheets, plate<br>Sheets, plate<br>Sheets, plate | 10% and 18% Ni<br>1%, 2% and 5% Sn<br>70/30, 80/20, 85/15, 87/13, 19/90, 95/5 |
| 174 | New Jersey Zinc Co.<br>New York, N. Y. | 10.6 | Horse Head | Powder | Complete range of compositions |
| | | 10.2 | Horse Head | Powder | 64 Cu–18 Ni–18Zn |
| | | 20 | Horse Head Special<br>Horse Head Intermediate<br>VFZ Brass Special<br>Lehigh | Slab zinc | |
| | | | Horse Head | Strip rolled zinc | All commercial compositions |
| | | | Zilloy | Strip rolled zinc | Zn–Cu–Ti |
| | | | Horse Head Zamak-3 | Ingot die cast | 4.1 Al–0.04 Mg–bal. Zn |
| | | | Horse Head Zamak-5 | Ingot die cast | 4.1 Al–1.0 Cu–0.04 Mg–bal. Zn |
| 175 | Nopco Chemical Co.,<br>Plastics Div.<br>N. Arlington, N. J. | 26.14 | | | Polyurethanes |
| 176 | North American Refractories Co.<br>Cleveland, Ohio | 25.4<br>25.5 | <br> | Standard sizes and shapes<br>Dry and wet condition | Low-duty to 90%-alumina brick<br>Including mortars, plastics and castables of various grades |
| 177 | Norton Company<br>Worcester, Mass. | 25.4 | | Brick, fired shapes, grain | Alundum aluminum oxide, Crystolon silicon carbide, Magnorite magnesium oxide, fused stabilized zirconia, fused mullite |
| | | 25.5 | | | Borides, carbides, oxides, nitrides |
| 178 | Olin Mathieson Chemical Corp.,<br>Metals Div.<br>New York, N. Y. | 6.1—6.6 | Olin | Rod, bar, extrusions, sheet, strip, plate, wire, pig, ingot, billet, electrical conductor | Common and heat-treatable alloys; clad sheets, 7000 series |
| | | 10.1—10.7<br>22 | Western Brass<br>Roll-Bond | Sheet and strip<br>Tube-in-sheet for heat exchangers | Over 40 alloys<br>Copper and aluminum alloys |
| 179 | Orangeburg Mfg. Co.<br>New York, N. Y. | 26.10<br>29 | SP<br>Orangeburg | Coils<br>Pipe | <br>Fiber drainage pipe |

| CODE | COMPANY | MATERIAL | TRADE NAME | FORMS | REMARKS |
|---|---|---|---|---|---|
| 180 | Owens-Illinois Glass Co., Kimble Glass Co. Sub. Toledo, Ohio | 25.1 | Kimax | Pipe and fittings | Tempered for extra durability |
| 181 | Owens-Corning Fiberglas Corp. New York, N. Y. | 25.1 | | Fibers, yarn | |
| 182 | Oregon Metallurgical Corp. Albany, Oregon | 11, 16, 21 | | Ingots, castings | Also Mo-alloys |
| 183 | Pennsalt Chemicals Corp., Corrosion Eng. Products Dept. Natrona, Pa. | 26.4<br>27.2.3 | RC-2525<br>Neoline | Pellets and powder<br>Packaged ingredients | Vinylidene-fluoride resin<br>Lining material for steel vessels |
| 184 | Pennsylvania Fluorocarbon Co. Philadelphia, Pa. | 26.4<br>26.11<br>26.14 | <br>Penntube<br>Genetron Penntube | Teflon tubes, rods, shapes<br>Tubes, rods, shapes<br>Tubes, rods, shapes | |
| 185 | Pfaudler Permutit Co., Pfaudler Div. Rochester, N. Y. | 3.1<br>3.3<br>3.3 | Glasteel<br>Pfaudlon<br>Nucerite | Custom forms<br>Custom forms<br>Custom forms | <br>Penton-coated metal<br>New ceramic-metal composite, available for field testing. Many metals, besides steel, can be coated. |
| 186 | Phelps Dodge Copper Products Corp. New York, N. Y. | 10.1<br>10.2<br>10.3<br>10.5<br>10.6 | <br><br><br><br> | Tubular<br>Tubular<br>Tubular and shapes<br>Tubular and shapes<br>Tubular and shapes | <br>10–40% Ni<br><br>5–10% Al<br>All compositions |
| 187 | Phillips Chemical Co. Bartlesville, Okla. | 26.10 | Marlex | Pellets | |
| 188 | Phoenix Steel Corp. Phoenixville, Pa. | 2<br>4.3<br>5.2.4<br>13.1<br>13.6<br>13.7 | <br><br><br><br><br> | Structural, plate, tubes<br><br>Tubes, pipe, seamless<br>Tubes, pipe, seamless<br>Tubes, pipe, seamless<br>Tubes, pipe, seamless | <br>Development stage<br>ASTM A335<br>ASTM A333–A334<br>ASTM 8630–8722<br>ASTM A4620, 4330, 4340, 4140 |
| 189 | Pittsburgh Corning Corp. Pittsburgh, Pa. | 25.1<br>25.2<br>26.14 | Foamglas<br>Foamsil<br>Foamthane | Flat blocks<br>Flat blocks, curbed segments<br>Board and blocks | Foamed-glass<br>Fused-silica refractory and insulating material<br>Foamed polyurethane |
| 190 | Polymer Corp. of Pennsylvania Reading, Pa. | 26.4<br>26.6<br>26.14 | Polypenco<br>Polypenco<br> | Rod, tape, tubing, sheet<br>Rod, tape, tubing, bar, plate (molding powders, sintered parts)<br>Rod, strip, tubing, pipe | Special composition of TFE fluorocarbon<br>Special filled materials with $MoS_2$, graphite<br>Chlorinated polyether (Penton) |
| 191 | H. K. Porter Co., Inc., Refractories Div. Pittsburgh, Pa. | 25.4 | | Standard and special brick shapes | Basic acid silica |
| 192 | H. K. Porter Co., Inc., Riverside-Alloy Metal Div. Riverside, N. J. | 4.2<br>4.2.1—4.2.3<br>4.3<br>4.5<br>7<br>10.2, 10.3, 10.6<br>13.1<br>13.2<br>13.3<br>13.6 | Isoloy<br>Amlet<br>Amlet<br>Amlet<br>Alloy 120<br>Riverside<br><br>Excelsior<br>Chromic A<br> | Strip and wire<br>Strip and wire<br>Strip and wire<br>Strip and wire<br>Rod and wire<br>Sheet, strip, rod, wire<br>Wire and strip<br>Strip and wire<br>Wire<br>Strip and wire | Standard and ELC analysis<br>Standard and ELC analysis<br>Types 430, 420, 434A<br>17-7 PH<br><br><br>A nickel<br>Monel<br>80-20<br>Inconel, Inconel X |
| 193 | Protective Lining Corp. Brooklyn, N. Y. | 26.10<br>26.12.1 | <br> | Sheets, tubes<br>Sheets | |
| 194 | Raybestos-Manhattan, Inc. Passaic, N. J. | 23<br>27.2.6<br>27.1<br><br>26.4 | R/M Asbestos<br>T/M Silicone Rubber<br>[Manhattan, Condor, R/M]<br> | Packings and gaskets, insulations and fireproof cloth<br>Molded and extruded parts, roll coverings<br>Hose, linings and coverings, packings, asbestos products<br>Resin, packings, gaskets | Fire and acidproof<br>For 100 F to 500 F.<br><br><br>Teflon |
| 195 | Reactive Metals, Inc. Niles, Ohio | 16, 21 | | Billet, bar, plate, sheet, strip | |
| 196 | Reichhold Chemicals, Inc. White Plains, N. Y. | 26.3<br>26.8<br>26.9 | Epotuf<br>Polylite<br>Plyophen; Varcum | Liquid, solid chunk<br>Liquid<br>Liquid, lump, powder | 100% reactive epoxies<br>100% reactive polyesters<br>100% reactive phenolics |
| 197 | Republic Steel Corp. Cleveland, Ohio | 2, 4.1, 4.2, 4.2.1, 4.2.2, 4.2.3, 4.3, 4.4, 15, 16 | Enduro | Rods, bars, sheets, strip, coil | Heat-resistant alloys are produced |

| CODE | COMPANY | MATERIAL | TRADE NAME | FORMS | REMARKS |
|---|---|---|---|---|---|
| 198 | Resistoflex Corp. Roseland, N. J. | 26.4 | Fluoroflex-T | Rods, bars, sheets | Polytetrafluoroethylene-lined pipe also produced |
| 199 | Revere Copper & Brass Inc. New York, N. Y. | 6.1—6.5 | | Foil, sheet, tube, rod, bar, shapes, forgings | |
| | | 10.1—10.7 | | Sheet, strip, plate, rod, tube, shapes, forgings | |
| 200 | Reynolds Metals Co. Richmond, Va. | 6.1—6.6 | | Ingots, sheet, plate, foil, extrusions, tubing, wire, bar, pipe, powder, granules, shot, fabricated components, rod | |
| 201 | Rogers Corp. Rogers, Conn. | 23 | | Sheets, fabricated parts | |
| | | 26.1 | | Pellets, powder | |
| | | 26.3 | | Pellets, powder | |
| | | 26.6—26.9 | | Pellets, powder | |
| | | 27.2.2 | | Molded and extruded parts | |
| | | 27.2.6 | | Molded and extruded parts | |
| | | 29 | | Sheet, fabricated parts | Reinforced Teflon |
| 202 | Rohm & Haas Co. Philadelphia, Pa. | 26.1 | Plexiglas | Cast sheets | |
| 203 | The Ruberoid Co. New York, N. Y. | 23 | Calsilite, Calsilite-Hi | Sectional, flat sheets | |
| 204 | Ralph V. Rulon, Inc. Philadelphia, Pa. | 3.3 | | Sheet, (steel and PVC) | |
| | | 24 | | Powder | |
| | | 25.4 | | Any shape | |
| | | 26.3 | Rulox | Liquid and powder | |
| | | 26.8 | Rulock | Liquid and powder | |
| | | 26.12.1 | Vilon | Sheet | |
| | | 27.3 | Nelon | Sheet | |
| 205 | Seal-Tite Manufacturing Co., Inc. North Wales, Pa. | 23 | Seal-Tite | Braided and twisted. | |
| 206 | Scovill Manufacturing Co. Waterbury, Conn. | 6.1 | Truspec | Sheet | 1100 |
| | | 6.3 | Truspec | Sheet | 3003 and 3004 |
| | | 6.4 | Truspec | Sheet | 5005, 5050, 5052, 5357 |
| | | 10.1 | | Rod, strip, tube | |
| | | 10.2 | | Strip, rod, wire, tube | Nickel silvers and cupro-nickel tube |
| | | 10.3 | | Strip, rod, wire | Bronzes |
| | | 10.4 | | Rod, wire | Low-silicon bronze |
| | | 10.5 | | Tube | Aluminum brass and aluminum-bronze tube |
| | | 10.6 | | Tube, rod, strip | |
| 207 | W. S. Shamban and Co. Culver City, Calif. | 26.4 | | Rod, tube, sheet, tape, custom | Filled compounds |
| | | 26.6 | | Rod, tube, film, strip, custom | |
| | | 26.11 | | Rod, custom | |
| | | 26.14 | | | Delrin, polycarbonates |
| 208 | Sharon Steel Corp. Sharon, Pa. | 1 | | Pigs | Basic iron |
| | | 2 | | Ingots, slabs, blooms, billets, strip | AISI and SAE specifications |
| | | 2 | | Ingots, slabs, blooms, billets, strip | Carbon steels |
| | | 4.1—4.4 | | Ingots, slabs, blooms, billets, strip | AISI and SAE specifications |
| 209 | Shell Chemical Co. New York, N. Y. | 26.3 | Epon | Resins, liquids, solids, solutions | |
| 210 | A. O. Smith Corp., Glascote Products, Inc. Cleveland, Ohio | 3.1 | Glascote | Tubular, fabricated equipment | |
| 211 | Spencer Chemical Co. Kansas City, Mo. | 26.6 | Spencer Nylon | Pellets | |
| | | 26.10 | Poly-Eth | Pellets, powder | |
| | | 26.11 | Poly-Pro | Pellets | |
| 212 | Stackpole Carbon Co. St. Marys, Pa. | 24 | | Plates, rods, bars | Many grades available |
| 213 | Stainless Foundry and Engineering, Inc. Milwaukee, Wisc. | 4.7 | Illium-R | Rod, bar, sheet, strip, wire | 68Ni-21Cr-5Mo-3Cu-1Fe, Mn, Si, C |
| | | 5.1.1 | | Sand castings | Types 405, 410, 416, 430 |
| | | 5.1.2 | | Sand castings | Types, 304, 316, 317, 321 |
| | | 9 | Illium-X, Illium-D | Sand castings | Special corrosion-resistant alloys |
| | | 13.1 | | Sand castings | Commercial pure nickel |
| | | 13.2 | | Sand castings | All grades—Ni-Cu alloy castings |
| | | 13.3 | | Sand castings | Corrosion-resistant grades |
| | | 13.5, 13.6 | | Sand castings | Corrosion-resistant grades |

| CODE | COMPANY | MATERIAL | TRADE NAME | FORMS | REMARKS |
|---|---|---|---|---|---|
| 214 | Standard Oil Co. of Calif.<br>San Francisco, Calif. | 26.8 | | Resins | Reinforced plastics |
| 215 | Standard Tube Co.<br>Detroit, Mich. | 2 | | Tubes | Boiler, condenser and heat exchanger |
| | | 3.3 | | Tubes, composite | With stainless or nonferrous alloys |
| | | 4.1—4.2.3 | | Tubes, pipe | |
| | | 5.2.3 | | Pipe, tubing | |
| | | 9 | | Tubes | Hastelloy grades |
| 216 | Stauffer Chemical Co.,<br>Molded Products Div.<br>Los Angeles, Calif. | 26.2 | | Pipe, fittings | Type I, Series 2 and 3 |
| | | 26.10 | | Pipe, tubing, fittings | |
| | | 26.12.1 | | Pipe, fittings | Type II, schedules A, 40, 80 |
| 217 | Stauffer-Temescal Co.<br>Richmond, Calif. | 8, 15, 18, 21, 22 | | Ingot | Electron-beam process |
| 218 | Studebaker-Packard Corp.,<br>Gering Plastics Div.<br>Kenilworth, N. J. | 26.1 | Gering | Pellets | |
| | | 26.6 | Gering | Pellets | |
| | | 26.10 | Gering | Pellets, sheet | |
| | | 26.12.1 | Gering | Pellets | |
| 219 | Superior Tube Co.<br>Norristown, Pa. | 1 | | Tubing | Ingot iron |
| | | 2 | | Tubing | 1008, 1010, 1015, 1020, 1025, 1035, 1045, 1095, 4130, 4132, 4140, 4150, 4615, 8630, 52100 |
| | | 4.2 | | Tubing | Types 303, 305, 309, 310, 321, 348 |
| | | 4.2.1—4.2.3 | | Tubing | |
| | | 4.3 | | Tubing | Types 403, 410, 420, 430, 446 |
| | | 4.4 | | Tubing | 502 |
| | | 4.5 | | Tubing | A-286, 15-7Mo, 17-7PH, 19-9DL, N-155 |
| | | 7 | | Tubing | Pure beryllium, beryllium copper |
| | | 8 | | Tubing | Pure columbium, Cb alloy with 1% zirconium |
| | | 9 | | Tubing | Haynes 25 |
| | | 13.1 | | Tubing | Low-carbon nickel, A nickel, D nickel |
| | | 13.2 | | Tubing | Monel |
| | | 13.6 | | Tubing | 80-20% Ni-Cr alloy (Inconel X) |
| | | 15 | | Tubing | |
| | | 16 | | Tubing | Pure titanium, 3% Al-2.5% V Ti alloy |
| | | 19 | | Tubing | |
| | | 21 | | Tubing | Pure zirconium, Zircaloy—2-3-4 |
| 220 | Sylvania Electric Products, Inc.,<br>Chem. and Met. Div.<br>Towanda, Pa. | 18 | | Powder, rod, wire, ingots, billets, pellets | |
| | | 22 | | Powder, rod, wire, ingots, billets, pellets | Mo |
| 221 | Charles Taylor Sons Co.<br>Cincinnati, Ohio | 25.4 | Taylor Zircon | Brick, cement, ramming mixes, shapes | Zirconium silicate |
| | | | Taycor | Brick, cement, ramming mixes, shapes | Bonded corundum |
| 222 | Taylor-Wharton Co.<br>High Bridge, N. J. | 2 | Tisco | Miscellaneous castings | ASTM A27-58, A 148-58 |
| | | 5.1.1 | | Castings | 14% Cr iron, 410,420 |
| | | 5.1.2 | | Castings | Type 316 |
| | | 5.1.3 | Timaxx | Castings | Austenitic Mn steel with Cr and Ni |
| 223 | Texas Instruments, Inc.<br>Metals and Controls Div.<br>Attleboro, Mass. | 4.2, 4.3 | | Sheets, bar | |
| | | 15, 16 | | Sheets, bar | Platinum clad |
| 224 | Texas-U. S. Chemical Co.<br>Port Neches, Texas | 27.2.1 | Synpol | Bales | Wide range of clear, oil-extended and carbon-black masterbatch types |
| 225 | Thermal American Fused<br>Quartz Co.<br>Dover, N. J. | 25.2 | Vitreosil | Rods, tubes | 99.9+% $SiO_2$ |
| | | 29 | Spectrosil | Rods, tubes | Synthetic fused quartz. This is the purest form of quartz presently available |
| 226 | H. I. Thompson Fiber Glass Co.<br>Los Angeles, Calif. | 25.2 | Refrasil | Cloth, tape, cordage, sleeving, bulk fibers, yarn | 96%-99% pure silica |

| CODE | COMPANY | MATERIAL | TRADE NAME | FORMS | REMARKS |
|---|---|---|---|---|---|
| 227 | Timken Roller Bearing Co.<br>Canton, Ohio | 2 | | Seamless tubes | |
| | | 4.2 | | Seamless tubes, bars, forging billets | Type 321 |
| | | 4.2.1—4.2.3 | | Seamless tubes, bars, forging billets | |
| | | 4.3 | | Seamless tubes, bars, forging billets | Types 403, 410, 420 |
| | | 4.4 | | Seamless tubes, bars, forging billets | |
| | | 4.7 | | Bars, forging billets<br>Seamless tubes | 16-25-6; 16-15-6<br>17-14 Cu Mo |
| 228 | Titanium Metals Corp. of America<br>New York, N. Y. | 16 | Timet | Sheet, strip, plate, bar, billet, tubing, wire | All commercially-pure grades, plus these alloys: Ti-5Al-2.5Sn; Ti-6Al-4V; Ti-7Al-4Mo; Ti-4A1-3Mo-1V; Ti-13V-11Cr-3A1; Ti-Pd |
| 229 | Trent Tube Co.<br>East Troy, Wisc. | 4.1 | | Tubing, pipe | Types 201, 202 |
| | | 4.2—4.2.3 | | Tubing, pipe | Types 301, 302, 302B, 303, 304, 304LC, 309B, 309S, 310, 310B, 314, 316, 316LC, 317, 319, 321,347, 348 |
| | | 4.5 | | Tubing, pipe | 17-7 PH. AM-350 |
| | | 4.6 | | Tubing, pipe | |
| | | 5.1.2 | | Heat resistant tubing | Inconel, Incoloy |
| | | 13.7 | | Tubing | Hastelloy B, C, F, X |
| | | 21 | | Tubing | Zirconium, Zircaloy |
| 230 | Union Carbide Corp.<br>Haynes Stellite Co.<br>Kokomo, Ind. | 5.1.2 | Haynes | Investment castings | Type 310 |
| | | 5.1.1 | Haynes | Investment castings | Types 410, 431LC, 431HC, 440C |
| | | 9 | Haynes | All standard mill forms, sand, resin shell, investment castings | |
| | | 13.3 | Hastelloy | Castings, all standard mill forms | Most commonly used is Hastelloy alloy C (54 Ni-15.5 Cr-16 Mo-4 W) |
| | | 13.5 | Hastelloy | Castings, all standard mill forms | Hastelloy alloy B most notable (61 Ni-28 Mo-5Fe) |
| | | 13.7 | Hastelloy | Sand castings only | Nickel-silicon alloy for sulfuric acid service (82 Ni-9 Si-3 Cu) or Hastelloy alloy D |
| | | 15 | Haynes | All standard mill forms | |
| 231 | Union Carbide Corp.<br>Linde Co.<br>New York, N. Y. | 4.2.2, 6.1—6.5 | | Powder (spherical) | |
| | | 8, 15, 19 | | Rods, bars | |
| | | 10.1—10.6, 13.1—13.6 | | Powder (spherical) | |
| | | 18 | | Rods, bars, powder (spherical) | |
| | | 22 | | Rods, bars | Molybdenum |
| 232 | Union Carbide Corp.<br>National Carbon Co.<br>New York, N. Y. | 24 | National — such as brick, porous graphite<br>Karbate — impervious graphite and carbon | Rods, cylinders, blocks, plates, tubes, bricks, powders, cloth, particles | Grades available: For graphite, AGSR, AGSX, CS, and ATL. For carbon, coke base and coal base. For Karbate impervious graphite: Karbate 22, phenolic impregnation; Karbate 26, modified phenolic impregnation; Karbate 21, epoxy impregnation; Karbate 25, modified epoxy-impregnation |
| 233 | Union Carbide Corp.<br>Union Carbide Plastics Co.<br>New York, N. Y. | 26.3 | Bakelite | Liquid, solid resins | |
| | | 26.9 | Bakelite | Molding powders, laminating and bonding resins | General purpose; heat, chemical, impact, electrical-resistant |
| | | 26.10 | Bakelite | Molding, extrusions resins, pellets | Low, med., and high density; copolymers |
| | | 26.12.1 | Bakelite | Molding, extrusion resins, pellets | General purpose; chemical and electrical-resistant |
| | | 26.14 | Bakelite | Molding, extrusion resins, pellets | Polystyrene, general purpose; medium high and extra-high impact; copolymers |
| 234 | Union Carbide Corp.<br>Silicones Div.<br>New York, N. Y. | 26.13 | Union Carbide | Resins, varnishes, fluids | For Class H electrical equipment operating in corrosive atmospheres; resins for high-temperature paints |
| | | 27.2.6 | Union Carbide | Pellets, sheet, direct-feed strips, solutions | Complete line of silicone rubber compounds, masterbatches, gums, and solutions |
| 235 | Union Carbide Corp.<br>Union Carbide Metals Co.<br>New York, N. Y. | 8 | | Powder, roundels, rod, bar, sheet | Min. purity, 99.6% |
| | | 8 | | Rod, bar, sheet | 65 Cb-7.5 Ti-0.75 Zr<br>Also 8% Ti alloy and 0.75% Zr alloy |

| CODE | COMPANY | MATERIAL | TRADE NAME | FORMS | REMARKS |
|---|---|---|---|---|---|
| 235 | **Union Carbide Metals** (Con't. from p. 211) | 15 | | Powder, roundels | Min. purity, 99.7% |
| | | 16 | | Powder | Range of alloys |
| | | 19 | | Powder, rod, bar, sheet | Min. purity, 99.6% |
| | | 25.4 | | Powder | Chromium and titanium carbides |
| 236 | **Union Steel Corp. Union, N. J.** | 4.2 | | | Types 320, 304, 304L, 305, 308, 309, 310, 314, 316, 316L, 317, 318Cb, 319, 319L, 321, 347, 348. |
| | | 4.2.1 | | | Types 304 and 304L (0.03 max. carbon) |
| | | 4.2.2 | | Pipe, tubing (welded, drawn, seamless) | Types 316 and 316L (0.03 max. carbon) |
| | | 4.2.3 | | | Types 316 and 316L (0.03 max. carbon) |
| | | 4.3 | | Pipe, tubing (welded, and drawn) | Types 410, 430, 446 |
| | | 4.6 | Union 20 Cb | Pipe, tubing (welded, drawn, seamless), sheet, plate, bar | |
| 237 | **U. S. Pipe & Foundry Co. Burlington, N. J.** | 1, 2, 3.1—3.3, 4.2, 5.1.1—5.2.4 | | Pipe and tubing | |
| 238 | **U. S. Rubber Co., Naugatuck Chemical Div. Naugatuck, Conn.** | 26.2 | Kralastic | | |
| | | 26.8 | Vibrin | | |
| | | 26.12.1 | Marvinol | | |
| | | 27.1 | | Bales, latex | |
| | | 27.2.1, 27.2.4 | | Bales, latex | |
| 239 | **U. S. Rubber Co., Textile Div. New York, N. Y.** | 23 | Asbeston | Fabric, yarns | |
| 240 | **U. S. Steel Corp. Pittsburgh, Pa.** | 2 | | Sheets, strip, plates, bars, shapes | |
| | | 4.1 | | Sheets, strip, plates, bars, shapes | Types 201, 202 |
| | | 4.2—4.2.3 | | Sheets, strip, plates, bars, shapes | All grades |
| | | 4.3 | | Sheets, strip, plates, bars, shapes | Types 403, 410, 416, 430 |
| | | 4.4 | | Sheets, strip, plates, bars, shapes | Types 501, 502 |
| | | 4.5 | USS Stainless W | Sheets, strip, plates, bars, shapes | |
| 241 | **U. S. Steel Corp., National Tube Div. Pittsburgh, Pa.** | 2 | USS National | Pipe and tubes | |
| | | 4.2—4.2.3, 4.3 | USS National | Pipe and tubes | Types 302, 303, 303Se, 304, 304L, 310, 316, 316L, 321, 321-H, 347, 348; 403, 405, 410, 414, 416, 416Se, 430 |
| | | 13.3, 26.10, 26.12.1 | USS National | Pipe and tubes | |
| 242 | **U. S. Stoneware Co. Akron, Ohio** | 25.3 | Ceratherm 55, Denstone 57 | Castings, molded shapes | |
| | | 25.5 | Alite | High alumina | |
| | | 26.4 | | Linings and tubing | |
| | | 26.5 | Duralon | Molding and casting resins | |
| | | 26.10 | | Tubing, sheets, rods, slugs | |
| | | 26.11 | | Tubing, sheets, rods | |
| | | 26.12.1 | Tygon | Tubing, rods, molded items, sheets | |
| | | 26.13 | Silicol | Molded items, sheets | |
| | | 27.1, 27.2.6, 27.3 | | Molded items, sheets | |
| 243 | **Universal-Cyclops Steel Corp. Bridgeville, Pa.** | 4.1—4.6 | Uniloy | Bar, billet, wire, strip, sheet | |
| | | 8 | Refractomet | Bar, billet, wire, strip, sheet | |
| | | 13.1, 13.3—13.6 | Unitemp | Bar, billet, wire, strip, sheet | |
| | | 15, 18 | Refractomet | Bar, billet, wire, strip, sheet | |
| 244 | **Vanadium Corp. of America New York, N. Y.** | 19 | | Bars, sheets, plates, wire, tubing, rods, strip | |
| 245 | **Variacoid Chemical Co. New York, N. Y.** | 4.7, 5.1.1, 5.1.2, 5.2.1, 5.2.3, 9, 13.2—13.6, 14 | | Powder | |
| | | 8, 15, 16, 18, 19, 21, 22 | | Rods, sheets, wire, foil, ingot, powder | |
| 246 | **Vulcanized Rubber and Plastics Co. Morrisville, Pa.** | 26.1, 26.6, 26.10, 26.11, 26.12.1, 26.13, 26.14 | | Molded to specification | All varieties |
| | | 27.1—27.3 | | Compounded, molded or extruded to specifications | |
| 247 | **Wah Chang Corp. New York, N. Y.** | 8 | | Billets, rod, wire, sheet, strip, foil, tubing, ingots, sponge | Pure Cb and alloys |
| | | 15 | | Billets, ingots, bar, rod, wire sheet, strip, foil, tubing, powder | |
| | | 17 | Double Circle | Metal | |
| | | 18 | | Rod, wire, sheet, strip, electrodes, crystalline powder, metal powders | |

| CODE | COMPANY | MATERIAL | TRADE NAME | FORMS | REMARKS |
|---|---|---|---|---|---|
| 247 | **Wah Chang Corp. New York, N. Y.** (Con't. from p. 212) | 21 | | Bar, rod, wire, sheet, strip, foil, tubing, ingot, fabricated parts, sponge | |
| | | 22 | | | Hafnium: same as zirconium listing |
| 248 | **Wall Tube and Metal Products Co. Newport, Tenn.** | 4.2—4.2.3 | | Seamless and welded stainless steel tubing | |
| | | 13.1—13.5 | | Seamless tubing | |
| 249 | **Wallingford Steel Co. Wallingford, Conn.** | 4.1 | | Cold-rolled strip, welded tubing and pipe | Types 201, 202, 204 |
| | | 4.2—4.2.3 | | Cold-rolled strip, welded tubing and pipe | Types 301, 302, 304, 304L, 305, 310, 316, 316L, 317, 318, 321, 347, 348 |
| | | 4.3 | | Cold-rolled strip, welded tubing and pipe | Types 410, 420, 430 |
| | | 4.4 | | Cold-rolled strip, welded tubing and pipe | Types 501, 502 |
| | | 4.5 | | Cold-rolled strip, welded tubing and pipe | AM-350, AM-355, PH 15-7Mo |
| | | 4.7 | | Cold-rolled strip, welded tubing and pipe | A-286, 19-9DL |
| | | 9 | | Cold-rolled strip, welded tubing and pipe | L-605, V-36 |
| | | 13.7 | | Cold-rolled strip, welded tubing and pipe | Hastelloys B,C,X, N-155, R, D-979, Rene 41 |
| | | 16 | | Cold-rolled strip, welded tubing and pipe | Ti 55A, 65A, 75A |
| | | 21 | | Cold-rolled strip, welded tubing and pipe | Zr, Zircaloy-2 |
| | | 22 | | Cold-rolled strip | 4750, HC-1, HC-4 |
| 250 | **Walsh Refractories Corp. St. Louis, Mo.** | 25.4 | | Brick, castables | |
| 251 | **Washington Steel Corp. Washington, Pa.** | 4.1 | MicroRold | Sheet, strip | |
| | | 4.2—4.2.3 | MicroRold | Sheet, strip | Types 302 to 347 |
| | | 4.3 | MicroRold | Sheet, strip | Types 410 and 430 |
| 252 | **Waukesha Foundry Co. Waukesha, Wisc.** | 5.1.1, 5.1.2 | | Castings | |
| | | 5.2.1—5.2.3 | | Castings | |
| | | 10.1—10.4 | | Castings | |
| | | 13.1—13.6 | | Castings | |
| 253 | **Westinghouse Electric Corp. Hampton, S. C.** | 26.3, 26.7, 26.8, 26.9, 26.13 | Micarta | Sheets, angle, rod, tube | Impregnated paper, fabric, asbestos, glass cloth |
| | | 26.10 | Micarta | Sheets | |
| | | 28 | Micarta | Bar stock | Phenolic binder |
| 254 | **Ichabod T. Williams & Sons, Inc. New York, N. Y.** | 28 | Ekki | Boards, planks, posts, blocks | Resists acid action |
| 255 | **Yardley Plastics Co. Columbus, Ohio** | 26.1 | | Extrude any shape | |
| | | 26.2 | | Extrude and mold all shapes | |
| | | 26.6 | | Mold any shape | |
| | | 26.10, 26.11 | | Extrude and mold any shape | |
| | | 26.12.1 | | Extrude any shape | |
| | | 26.14 | | Extrude and mold any shape | Styrene |
| 256 | **Youngstown Sheet & Tube Co. Youngstown, Ohio** | 2 | Yoloy | Pipe, conduit, sheets, plates, bars | Nickel-copper alloy steel (Approx. 2% Ni, 1% Cu) |
| 257 | **Youngstown Sheet & Tube Co., Fibercast Co. Div. Sand Springs, Okla.** | 26.3 | Fibercast | Reinforced epoxy pipe and fittings | Glass-epoxy |
| | | 26.8 | Fibercast | Reinforced polyester pipe and fittings | Glass-polyester |
| 258 | **Zirconium Corp. of America Solon, Ohio** | 25.4 | | Brick | Zirconium oxides, dense and insulating |
| | | 25.5 | | Rod, tube, brick, plates | Zirconium oxides; refractory-metal and rare-earth oxides |
| 259 | **Zirconium Metals Corp. of America New York, N. Y.** | 21 | | Sponge, ingots, billets, slabs, strip, sheet, plate, powder, wire | Commercial zirconium, reactor-grade zirconium, Zircaloy-2, Zircaloy-4 |
| | | **LATE ADDITIONS** | | | |
| 260 | **Carl N. Beetle Plastics Corp. Fall River, Mass.** | 26.3, 26.8 | | Sheets, tubes, pipe | |
| 261 | **Borden Chemical Co. New York, N. Y.** | 26.1, 27.2.1 | Polyco | Liquid, powder | |
| | | 26.9 | Cascophen | Liquid | |
| | | 26.12.1 | Cascores | Powder, liquid | |
| 262 | **Copolymer Rubber & Chemical Corp. Baton Rouge, La.** | 27.2.1 | Copo | Liquid latex | |
| | | | Carbomix | Bales | |

# Inventory of Current Literature

**3** *For information on basic materials of construction, use this list of new (issued or revised since 1958) literature. For copies, mail in the special Reader Service Card, page 293.*

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| Bart Laboratories and Design, Inc. | —— | x | x | | x | x | x | | x | | 8 | Lectro-Clad pipe, fittings and tubing | M-16 |
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| Pfaudler Permutit, Inc., Pfaudler Div. | 985 | x | x | x | x | x | x | | | | 20 | Glasteel, complete tech. data | M-26 |
| Weirton Steel Co. | —— | x | | | x | x | | | | | 7 | Zinc-coated steel, electrolytic | M-27 |
| | —— | x | | | x | x | | | | | 11 | Zinc-coated steel | M-28 |
| **ALLOY STEELS** | | | | | | | | | | | | | |
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| | F-20153 | | x | x | | | | | x | | 6 | Austenitic alloys | M-41 |
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# Troubleshooting New Processes

**Getting a process on the line and keeping it there takes experience, for which this article is no substitute. But we can help you avoid unpleasant surprises.**

J. E. TROYAN
*Olin Mathieson Chemical Corp.*

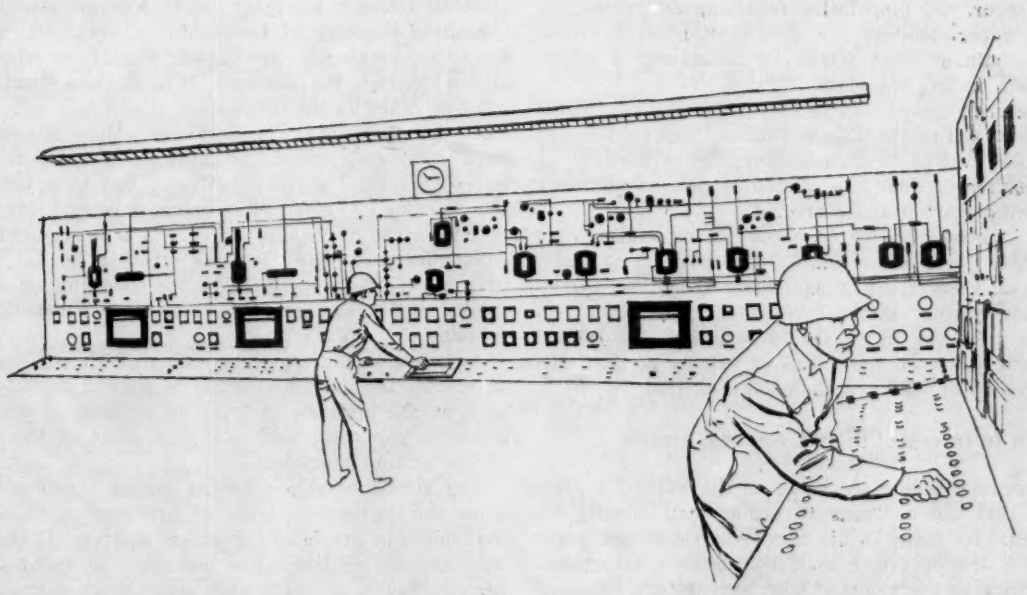
Proving out a new plant or process is ordinarily a tougher job than keeping an established operation on the line. More emergencies tend to arise and more unknowns exist. Until the operator gets the bugs out of the equipment and determines routine operating patterns, the new plant demands patience, ingenuity and plain hard work.

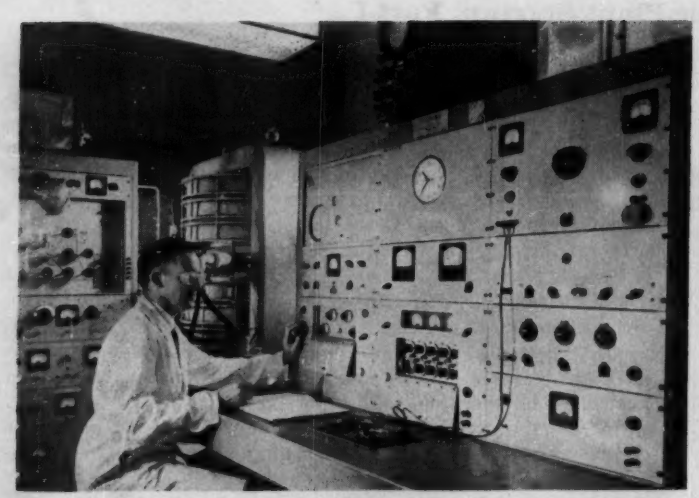
In this article, we will attempt to present a broad summary of typical operating aids and techniques that have been found useful in some plant startups. These may not always be applicable since new problems require new answers. However, we can meet the challenges of regular or startup operations more easily when we are able to draw upon the accumulated know-how derived from past experience.

Operators should be alerted to watch for leaks of hazardous or toxic vapors, plugging up or fouling (as evidenced by pressure drop), contamination of process streams by dirt or other materials, loss of pump suction due to starved feed or vapor lock, and other conditions. Such things may be encountered often during startup of a new plant. Difficulties will crop up where they are not expected, and actually may not occur where anticipated.

Since the plant operator is exposed to many more problems during startup than in a lined-out operation, he must be acquainted with the range of difficulties that he may encounter. You should emphasize such things during training, particularly during the simulated operation phase where some of the equipment problems will start to show up.

Where problems are likely, or can be anticipated, make note of them in the standard operating procedures. Where symptoms can be described, but immediate solutions cannot be defined, the procedures should instruct the operator to bring any unusual







**Sample analysis can provide important information on the state of the process, help pinpoint trouble. Analytical equipment can be as simple as the field Orsat analyzer (right) or as complex as this mass spectrometer (left).**

conditions to the attention of the supervisor in charge.

Safety and uniformity of operation demand that personnel follow standard procedures. Each shift will then know that the previous group has been doing the job properly. If each shift tends to deviate from the standard operating procedure, it becomes difficult to confirm reasons for success or failure in the process operations. Often, good vs. bad product quality can be traced to slight variations in interpretation of the operating procedures.

Separate log records or data tabulation sheets for particular pieces of equipment or critical parts of a process can help establish causes of difficulties when they occur. By pinpointing recurring difficulties, the plant superintendent can direct attention to these and eliminate what might be considered a minor problem on any one shift.

Operating people can become accustomed to minor problems and accept them as routine. But such things as sticky valves or chronic plugging in portions of the equipment should be spotted by process engineers following startup and corrected.

It is good practice to check valves routinely to prevent upsets or accidents. The position of every valve on every place of equipment should be double-checked during startup. When shutting down, isolating valves in piping should be closed. In critical operations, record the status of valving so that successive shifts will know the plant condition.

## Learn to Interpret Sights, Sounds, Smells

Operators should always be on the watch for problems that can be "sensed" rather than directly observed. By fixing in his mind what is standard and proper, the operating man will become accustomed to critical or key points of flow, temperature, pressure, and even smells, sounds and other characteristics of the process. He should then be able to spot deviations from these standards in any number of ways.

We describe below some typical trouble indicators and conditions that you might encounter:

Noisy equipment can mean poor lubrication, a blown rupture disk or safety valve, a foreign body in the equipment, or a loose or worn part.

Vibration can indicate that the equipment needs better anchoring, or that a hanger or support has come loose, or that there is binding of moving parts.

Leaks can be smelled, heard and seen. Rapid detection and prompt elimination of leaks is one of the essential duties of the plant operator during startup.

Routine checking of temperatures, pressures, and flows, as previously mentioned, should be almost second nature to the operator. If he marks a standard point or range on the instrument, it will help indicate when the operation is going off-spec. Many processes have warning signals on the panel board that indicate improper control or malfunctions. But even before the warning is given, the operator should try to note the trend or change, and correct it as required.

Samples may often indicate whether or not the unit is working properly. Obvious coloration or contamination is an immediate signal that something is amiss.

An operator can sense the status of his equipment or process through observation of normal conditions, such as the presence of frost on a vessel, steam in a vent, a particular level in a gage glass, or the feel of hot or cold equipment.

You should develop solutions during training sessions for the various types of problems or troubles that might be predicted for a plant startup. It should be automatic or instinctive procedure to swing into certain courses of action when troubles are diagnosed.

The process engineer should have established steps in the training manuals telling when and how primary variables are to be adjusted to eliminate difficulties.

### Temporary Lines Can Get You Out of Trouble

Often during startup, temporary or jumper lines are required to keep a process running or to accomplish something not possible with the unit as designed. These jumpers can be hoses, flexible copper tubing, or regular piping put in temporarily.

You must have suitable connections to make these installations. Strategic location of drains, taps, tees, etc., in piping layouts will supply the necessary spots for tie-in. Drains on steam traps, vents on exchangers and pressure-gage connections are typical places where hoses may be connected to circumvent an operating impasse.

Sometimes, you must hot-tap to provide a connection. This procedure lends itself preferentially to gases, steam, water and other common, nonhazardous materials. There have been numerous articles on the techniques that basically include the following steps: welding a collar to the pipe being tapped; adapting a valve and stuffing-box assembly to the coupling so that a hole can be drilled into the active process; shutting the valve after partial removal of the drill; and completing remaining tie-in piping.

Temporary lines may be necessary under the following circumstances: (1) to bypass a leak that cannot be repaired immediately, but that must not be allowed to continue; (2) to bypass a section of plugged line; (3) to provide supplementary flow where the original line is undersized; (4) to bypass a piece of equipment that must be taken out of service; and (5) to inject materials into equipment for purging, flushing, chemical process needs, etc.

### Leaks Can Shut You Down

Two basic kinds of leaks occur in chemical plant operations: those between the process and atmosphere, and those within the process. External leaks are reasonably easy to observe and can usually be corrected or bypassed as discussed above. Internal leaks, including those where air is drawn into the process by vacuum, are more obscure. Their existence is often indicated only through secondary effects on the process.

There are certain measures you can take when leaks threaten a shutdown and it is essential that the equipment be kept on stream. You can temporarily relieve pressure or stop flow while tightening the leaking flange, packing follower, fitting or whatever. You can put a temporary patch over the leak and apply pressure by clamps or wrappings to hold it in position. You can use various proprietary cements, cold solders and plastic formulations to fill cracks or holes. You can peen the leak shut or put a plug in it.

Other remedies include pouring concrete around a break in ceramic or cast-iron pipe—usually applied on underground sections, freezing the area adjacent to the leak with dry ice or other coolant to isolate the section, or injecting suitable solids into the process fluid so that solids carried to the leak form a seal.

When leaks occur within the process, they are difficult to detect and often as hard to correct. Leaking valves are a common source of such trouble. A significant leak can be detected by temperature change or the sound or feel of the valve. Slow leakage, however, requires isolation of a section of piping so pressure rise can be noted. Leakage can also be confirmed by opening a vent in the isolated section.

You can determine that leakage is taking place by analyzing utility or process streams for the possible contaminant.

Color contamination, or two phases where there should be only one, can also indicate that internal leakage is occuring.

### Plugs Plague All Plants, Old and New

Plugging of liquid or vapor lines is a common occurrence during plant startup. Experienced operators have a number of techniques that can be applied to eliminate this difficulty. The simple expedient of rapping carefully on a line with a wrench to cause vibration may break loose thick slurries or solids.

Where there is a positive plug that cannot be broken by ordinary pressures, you can hook up a hydraulic pump and apply higher pressures. In using this technique, take care to prevent aggravation of the plug or damage to the equipment. High-pressure nitrogen can be used in the same manner.

Frequently, an operator may use a technique called "rocking" the system, where he rapidly raises and lowers the pressure to dislodge material.

External application of heat by steam, hot water, or even flame, will clear plugs caused by solidification of high-melting material. Electrical windings or strip heaters can also be applied to the same end. Steam tracing with flexible copper tubing overlaid with insulation tape or jacketing is most common.

Processes handling solids or slurries are frequently plagued with plugging problems, particularly during startup. Chemical removal of these plugs is frequently required when the material is otherwise difficult to get at or remove. The more constricted the channels being cleaned, the more difficult cleaning by this method will be unless good circulation is established. The procedure does not work well where many alternate flow paths are possible, such as in tubes of exchangers.

Water is the preferred cleaning agent if it will dissolve the material. But in some processes, the materials causing the plugging may be too reactive with water, in which case the cleaning solution must be modified.

When using temporary hoses on slurry or sludge containing streams, you should have an air or gas connection available for purging.

Steam purges are very useful when dealing with materials that tend to set up if the temperature drops too low. This would include such products as naphthalene and crude oil that are not affected by traces of water from condensed steam.

When starting up plants, it is frequently necessary to purge air from the equipment before introducing process materials. When shutting down for repairs or inspection, the reverse procedure may be necessary—you might have to purge the process material.

To save purging time, you should isolate a minimum volume of the process with block valves or blind flanges to permit localized venting and purging.

When a process contains poisonous, explosive, pyrophoric or other hazardous materials, you may need a number of specialized techniques for purging, before opening the equipment to the air. Generally, you can follow two systems:

1. Blow down or vent the material to atmosphere directly, through special vents or scrubbing systems, followed by (a) evacuation by steam jet or mechanical vacuum pumps or (b) purging with inert gas, such as nitrogen, $CO_2$ or natural gas.

2. Flush the equipment by positive displacement, or by pressuring and venting a number of times.

Let us consider in more detail the pressure-venting technique where we wish to eliminate a volatile material. Though evacuation can be incorporated into this sequence, it is normally employed only where the material has a low volatility. You should also avoid evacuation when there is a possibility that air-in leakage to the system may be hazardous.

Purging should clean up simple systems readily after initial blowdown. Where intricate piping and equipment is involved, however, results may be less than perfect.

Complicated systems, therefore, should be pressured and vented several times. You can calculate the number of cycles necessary to complete the purging by determining the maximum allowable residual concentration of contaminant in the system. For example, a single purge in which the inert gas pressure is raised to 105 psia. and then vented to atmosphere will leave about 14% of the contaminant in the process. A second cycle will reduce the contaminant to 2%, a third to about 0.3% and a fourth to 0.04%.

Properties of the contaminant will determine whether purging must be carried only below the lower explosive limit or to some concentration that is below the maximum allowable toxicity limit.

Even the purge diluent must be carefully selected when handling certain special materials. Argon, helium, hydrogen or $CO_2$ may be preferable to nitrogen or natural gas in some systems.

Bear in mind that after a system has been thoroughly purged with an inert gas, it must not be entered without proper personnel protection.

Final flushing of a system with air may be desirable after the inert purging steps have brought the contaminant to an acceptable level.

### Careful Operation Saves Time and Money

How often have we heard of incidents where batches have been run to the sewer by error, or materials have been mixed by mistake? To prevent this sort of problem in plant startup, it is good operating procedure to double-check levels in process equipment as material is transferred from one place to another.

Keep in mind the basic material balance concept and make mental calculations to see that there is consistency between transfers and receipts. Never unload into a tank or system without calculating, at least roughly, whether there is enough space. Check valves for proper settings, particularly bottom valves.

Sample valves or plug cocks that the operator thought "were turned the other way" can cause grief.

What do you do when you cannot convey material from one process section to another because the regular installed pump is inoperable? Experienced operators have a number of techniques that could work.

They might apply pressure to the tank, forcing the contents to flow where desired. In this case, you must consider the pressure rating of the tank.

In another variation, you can apply vacuum to the receiving system to get the same effect as pressuring the sending tank. Again, you must consider the vacuum rating of the equipment.

If the transfer problem is due to a plugged or vapor-locked pump, then the pump must be cleared. Techniques for getting pumps to work will be discussed at length in another article. But here are two simple tricks: If the pump is partially plugged, blowing backwards through the pump into the tank being emptied will often clear it. If it is vapor-locked, venting or cooling the pump may cure the trouble.

(This article, the first of two dealing with new-plant troubleshooting, is the promised sequel to "How to Prepare for Plant Startups in the Chemical Industries," by the same author, that appeared in the Sept. 5, 1960, issue of *CE*.

The second article, on troubleshooting equipment, will appear in an early issue. Clip and save these articles with your copy of the report.—Editor.)

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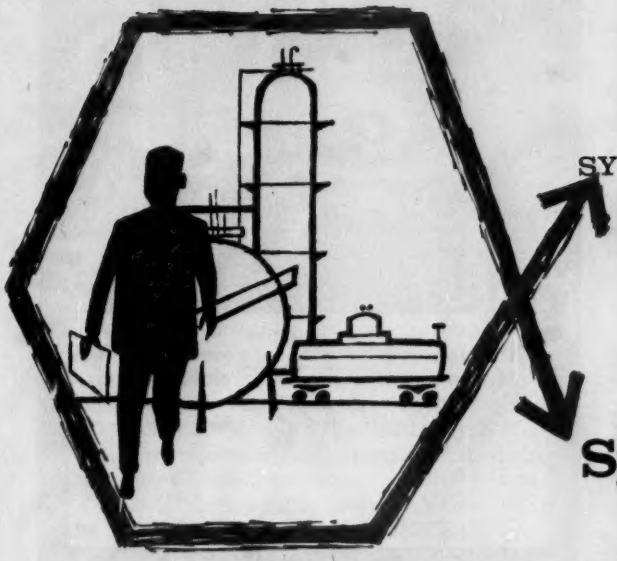
Meet the Author



J. E. TROYAN *is production manager of Olin Mathieson's Doe Run, Ky., plant. Previously, he was production manager of O M's Air Force high-energy-fuels plant at Model City, N. Y., and participated in the startup of the smaller Navy HEF plant at the same location.*

*Mr. Troyan is a chemical engineering graduate of Case Institute of Technology, a member of ACS, AIChE and Alpha Chi Sigma and holds a P.E. license in Connecticut.*

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SYSTEMS ENGINEERING, PART 10

# Systems Literature

**To show project engineer how systems work has succeeded, the systems group cites eight articles.**

THEODORE J. WILLIAMS, *Monsanto Chemical Co.*

Having presented the process engineers of Quandary Chemical Co. with some rudimentary details of process control theory and control system design, the systems group received the following memorandum from their old friend, Joe Smirk.

MEMO

**FROM: Joe X. Smirk**

**TO: Systems Engineering Group**

**We've seen what you could do in getting our process out of a bind, and we appreciate the instruction your group has been giving us on the theory behind your work. Several of our people, however, are still not convinced that there is anything to this "systems stuff." They feel you have just been lucky in working out the process development and troubleshooting of our last plant. Can you give us some examples of studies that others have made and the results they attained with their systems programs? This should help convince them that you're on the right track.**

Although systems engineering in the process industries is still quite new (less than six years old as of this writing), the literature contains eight articles describing ways to apply all or part of the procedures outlined in this series.* Several articles give results obtained and some economic benefits associated with them. A majority of the articles concern themselves with the advantages to be gained from an analog computer simulation of the process or plant in question.

There's an understandable reluctance on the part of management to permit publication of systems work. A larger number of articles aren't yet available† because of the proprietary nature of most of this work. For this same reason, none of the quoted articles gives the complete story about the application involved. Taken as a group, however, the articles do serve to point out some benefits to be derived from the systems approach and to prove its worth as an aid to engineering design and plant operation.

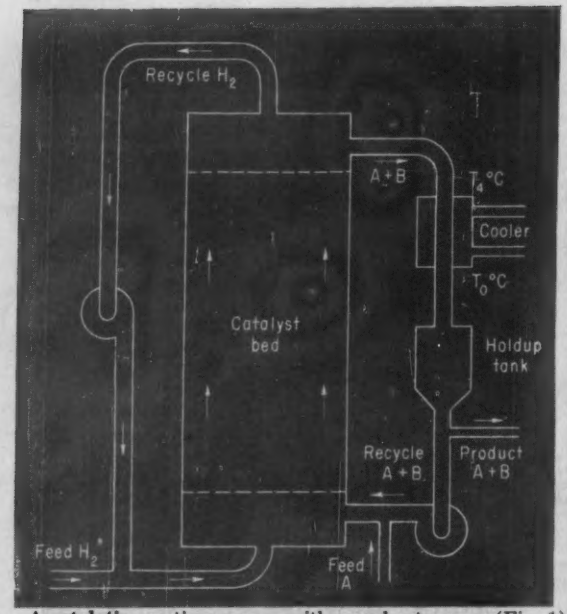
The articles we review here will be classified by types of chemical processing equipment. These are chemical reactors, evaporators, distillation and related separation operations and a plant waste disposal system.

## Reactor Design and Control

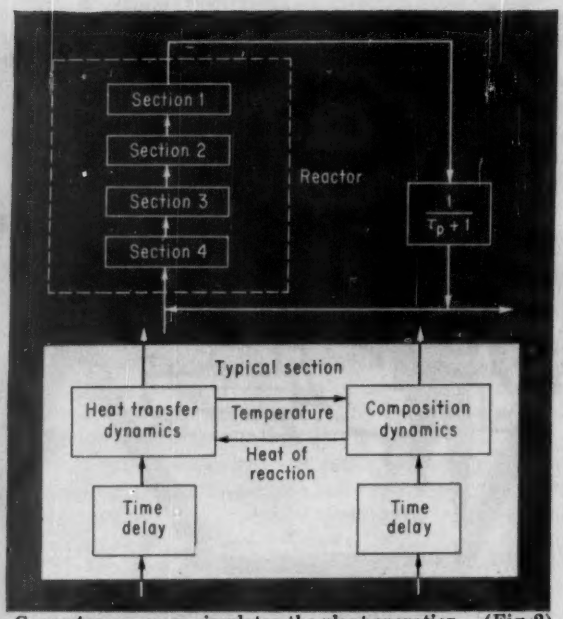
Worley, Franks and Pink[a] show how an analog computer was used to help design the optimum control system for a batch reactor whose temperature profile had to be maintained within 1° F. during a widely varying temperature cycle of operation. This paper,

* Based on the 1959 Schoch Lecture at the University of Texas, the series has appeared in *Chemical Engineering*, Feb. 8, 1960, pp. 121-16; Mar. 7, pp. 131-6; Apr. 4, pp. 139-44; May 2, pp. 121-6; May 30, pp. 97-102; June 27, pp. 113-118; July 25, pp. 119-124; Aug. 22, pp. 127-132; Oct. 17, pp. 181-186.

† But, see *Chem. Eng.*, this issue, pp. 110-4, and *Control Eng.*, Nov. 1960, pp. 103-14 for description of application of computer control to an ammonia plant.




A catalytic-reaction process with recycle stream.—(Fig. 1)




Computer program simulates the plant operation.—(Fig. 2)

which also gives an excellent discussion of the analog computer circuits required to solve various parts of the problem, shows the total inapplicability of various proposed single-loop controls. Further, it develops the cascade-control system that was necessary to give the degree of temperature control desired. This article shows advantages of computer simulation for trial-and-error proof of a proposed control-system design prior to construction rather than field-testing the proposed system after the plant is built.

In another article, Batke, Franks and James[1] describe procedures in using analog computer simulation to determine the proper control system for a catalytic hydrogenation reactor that exhibited cyclical performance in operation. Though the article doesn't disclose the nature of a troublesome byproduct, or give the final control system design evolved, it is important for its discussion of the successful method of attack to use on such problems.

Fig. 1 shows the over-all process. Note the inclusion of all the elements making up a complete processing plant—for instance, as in the process that forms the discussion example for this *CE* series on systems engineering. It's the recycle streams in both cases that can lead to plant cyclical operation or even instability.

Fig. 2 outlines the analog computer simulation program required to represent the plant's operation. Dynamics associated with the cooler or with the gas recycle stream have been ignored. For simulation, the reactor has been divided into four well-mixed sections, each with an associated time delay. This approximates the intermediate action between that of fully stirred tank dynamics and that of a completely plug-flow regime that exists in a packed-bed catalytic reactor.

Each section is approximated by a transfer function for temperature similar to

$$T_2/T_1 = Ke^{-\theta}/(\tau p + 1)$$

The actual expression used by the authors was somewhat more complex, however, since it also included reaction terms. In chemical process dynamics studies, the approximation shown here is often used to represent much more complicated systems. Careful selection of $G$ and $\tau$ can often give a good representation.

In yet a third paper, R. G. E. Franks of Du Pont discusses and illustrates in general terms a method of attack for analog simulation of a complex reaction system that includes a reactor and its associated separation equipment.[6] Particularly of interest is his discussion of methods of handling control system components, such as valves and controllers, and his derivation of the equation and computer diagram for a partial condenser.

## Distillation and Solvent Recovery

Three reports discussed here are concerned with control of distillation and absorption systems. The paper by Lewis[5] is probably the most complete of these.

Lewis used analog simulation to prove system stability and control system design for revision of a solvent recovery system that permitted great economy in utilities required to operate the process. Since use of countercurrent heat exchangers as heat economizers in this process caused a "positive feedback" or control

"destabilizing" effect, choice of a control system was a necessary part of the study.

Because of the complexity of the actual plant systems, numerous approximations to the actual dynamics of the various plant units were necessary. This article is especially valuable because of its discussion of such simplifications, and for pointing out the relative importance of these plant units in the computer simulation.

Even with the numerous approximations required, Lewis' simulation gave a quite accurate prediction of actual plant responses. It showed increased instability of the plant both at low feed rates and as the concentration of solvent in the feed increased. Periods of oscillation and amount of damping in the plant were reproduced as were the amounts of proportional band and reset required on the controllers. Fig. 3 shows the original and revised plant diagrams and serves to illustrate the control problems caused by this change.

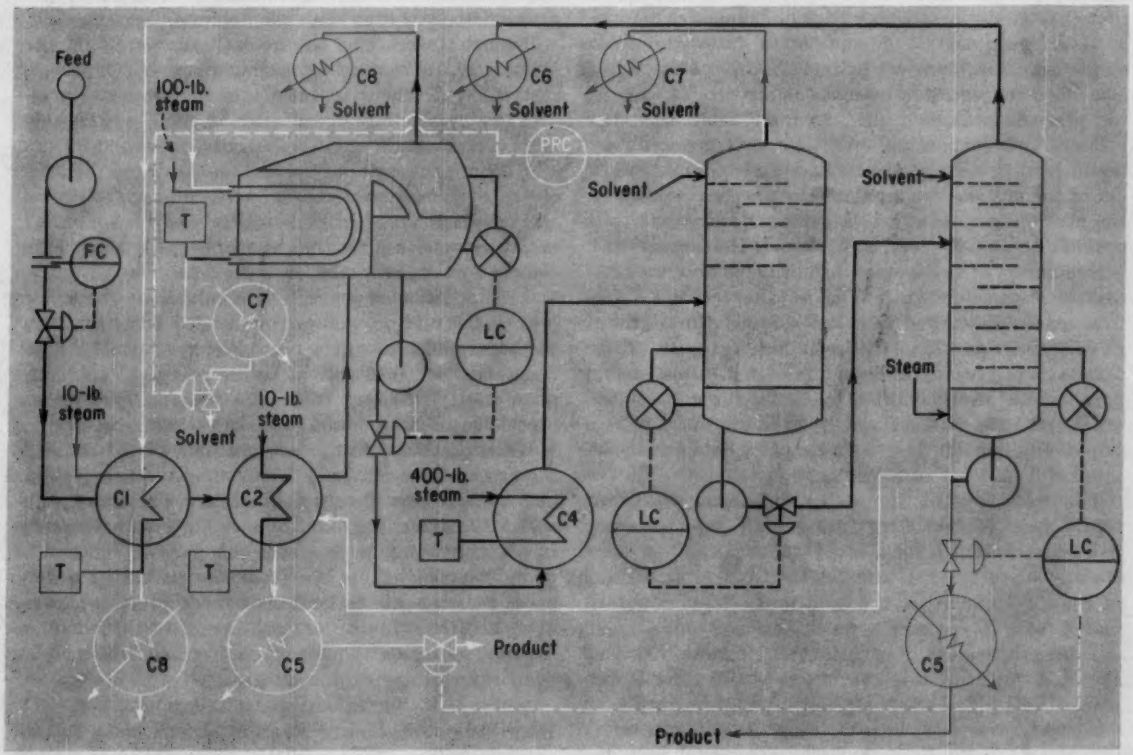
Woods[4] describes how determination of the transfer function of a distillation-column control system by plant experimentation led to theoretical determination of the best controller settings for the process.

He describes the original method of testing the column and, more important, gives a detailed description of the reduction of these data to obtain the most probable transfer function of the top portion of the column. This transfer function was approximated as two first-order lags and a dead time.

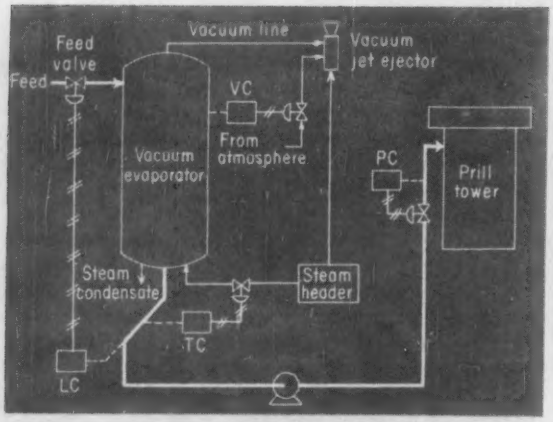
The larger first-order lag of 1.05 min. was attributed to response of the temperature detector, thermowell and transmission tubing. Dead time of 3.0 min. was attributed to actual physical holdup of liquid on the trays between the temperature sensing point and the top of the column.

Woods then goes on to describe the graphical trial-and-error procedure required for determining optimum controller settings. Since, in form, he has an almost identical control model, this discussion follows closely the one already presented in Part 9 of this *CE* series. The required procedure is developed differently than that described in the earlier part of this series, however, and thus is valuable for the reader's study because of the different approach.

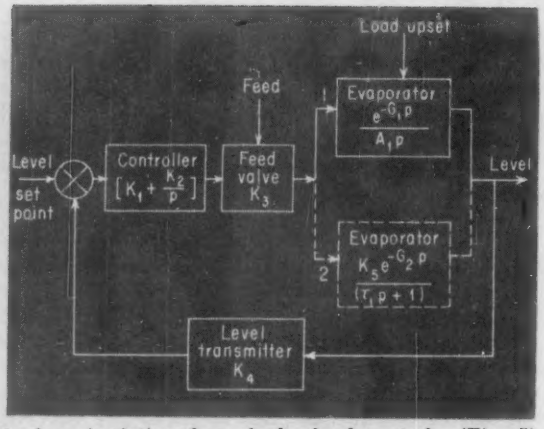
The second Woods article[5] shows how the analog computer was used to "choose" between two possible piping arrangements for adding an additional scrubber to a four-stage stripper-scrubber train, with the proposed control system for each. Results of this study show excellent agreement between computer simulation and later plant tests and again serve to point out the desirability of such steps prior to plant installation.




**Flowsheet** of solvent recovery plant shows "before" and "after" of plant change. Before revision of plant to recover waste heat, flow lines followed solid-color lines; after revision, these were eliminated, white flow lines added.—(Fig. 3)




**Original control system proposed for evaporator.—(Fig. 4)**




**Analog simulation first checks level control.—(Fig. 5)**

D. E. Johnson of Shell Development Co. has given what's believed to be the first published report[1] of process dynamics and control of vacuum evaporators. He doesn't answer all the problems that he raises in his report, but it's an excellent beginning.

The evaporator and control system design shown in Fig. 4 was presented to Shell Development's instrumentation department by the designer with a request that they study it and suggest any changes necessary to assure good control. Steam flow to the steam chest of the evaporator was set by temperature of the liquid effluent, a concentrated urea-water mixture. Evaporator pressure was controlled by an air bleed on the ejector, and evaporator feed flow was governed by liquid level in a standpipe below the evaporator. Flow out of the system was regulated by pressure control on the next operation in line (a prilling tower) and thus couldn't be used for level control, as is the normal case.

Simulation of the system that included only the level control loop, as shown in Fig. 5 (alternative 1), was first made. It showed that the assumed "dead time" $G_1$ of 9 sec. was all out of proportion to the standpipe area $A$ (not revealed). Even the best possible control permitted a level variation of 66 in. for a 10% load upset from the effluent flow. Accordingly, the pipe was tripled in diameter (i.e., $9A$) resulting in a level variation of 6 in. for a 10% load change.

Following construction of the evaporator, but prior to its test, further literature search revealed some published data that indicated the desirability of a slightly more complex simulation using alternative 2 of Fig. 5. In addition, the dead time $G_2$ was now estimated to be 23 sec., and $\tau_1$ was taken as 24 sec.

Although too late to correct, this simulation showed that the expected level variation would now be increased to 14 in. In this simulation, the assumed dead time was associated with flow over the heat-transfer surfaces; the time constant was associated with the solution distributor tray. In the original solution, the 9 sec. had been estimated as the flow-through time of liquid in the evaporator, an estimate later shown to be in extreme error.

When the evaporator was first put on stream, the level control was inadequate, variations being much larger than expected. As a result, the first control system was discarded, and the revised system shown in Fig. 6 was installed. At the same time, frequency response tests were made to determine, if possible, what had been wrong with the original analysis.

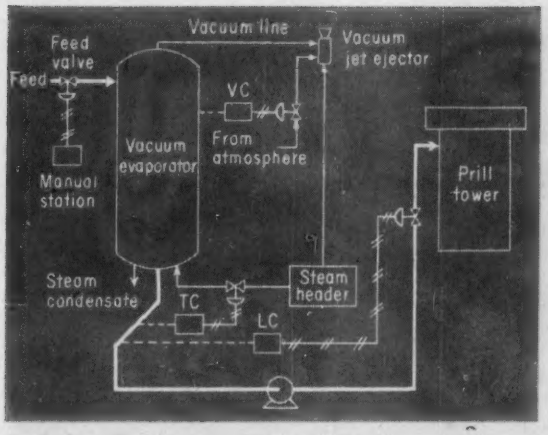
These tests revealed the necessity for treating the revised control system by a simulation as complex as that of Fig. 7. The effect attributed to evaporator pressure had been totally unexpected, as had the extremely large size of the $G_2$ and $\tau_1$ values of 38 sec. and 53 sec.

Although the new control system stabilized the level control system, fluctuations in the vacuum system could still cause a change in evaporation level of 8.5 in./0.1 in. Hg change in pressure. A more-sensitive pressure control system, i.e., smaller time constants $K_5$ and $\tau_2$, and the addition of a pressure regulator on the steam line to the ejector were recommended for correcting the latter difficulties. The much larger evaporator dead time and time constants were the source of the completely unsatisfactory control of the original system, especially when combined with the vacuum upsets.

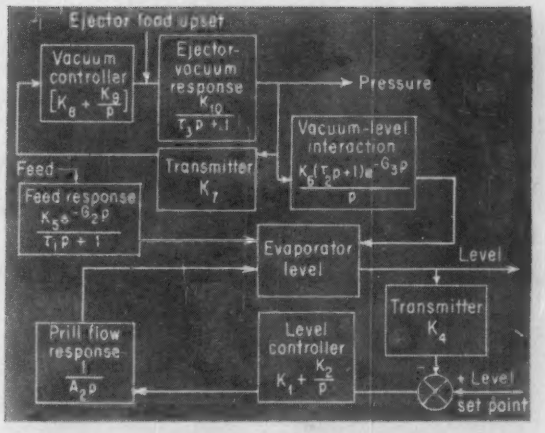
While pointing out the extreme difficulty of estimating process time constants from only rudimentary data, and the dangers involved in such a procedure, this article illustrates the value of such a preliminary study in pointing out sources of possible errors. Johnson is to be commended for his frankness in listing differences between his estimates of these process parameters and the actual values and the effect these had on system responses. The next researcher who tackles evaporator control will profit greatly.

## Plant Waste Disposal System

Perhaps the most complete and helpful article to a reader seeking a background in systems engineering is




**Revised** control system used on the evaporator.—(Fig. 6)




**Final** block diagram shown by frequency response.—(Fig. 7)

that by W. B. Field describing planning, analog simulation and design of a pH control system for use with a plant waste disposal system.[2]

Field begins his discussion by listing seven steps that he considers to be the major activities in the systems engineering of such a plant:

1. Writing an accurate statement of the problem.
2. Making a complete literature search.
3. Developing the process system for simulation (i.e., developing the process mathematical model).
4. Programming and wiring the analog computer from the mathematical model.
5. Testing the analog model to prove its ability to simulate the desired process.
6. Logically experimenting with the computer to develop the best plant design—a complete, but realistically planned trial-and-error procedure.
7. Building the plant, evaluating its performance.

He also lists three advantages of the systems engineering-analog simulation approach which we repeat here for emphasis, even though they may be the essence of statements we have made earlier in this series:

- The method forces the engineer to make a detailed and thorough assessment of the system under study. The inherent properties must be understood, and with that understanding come new concepts that can then be conveniently tested for feasibility on the analog computer.
- A realistic analysis can be made of various characteristics from interpretations of the behavior exhibited by the computer model. The systems engineer can actually "see" the action exhibited at any intermediate point in the model. And since the analog computer model includes all the characteristics (chemical, mechanical and instrumental) of the system, the process can be studied as an integrated whole.
- A system design so derived permits a full, quantitative set of specifications to be drawn covering both static and dynamic conditions.

In developing the statement of his problem, Field made an in-plant survey and certain experimental measurements. He found that his proposed system would be subject to three major independent variables:

1. The input pH could vary between 1 and 13—a 12-decade range of hydrogen-ion concentration. In addition, pH could change at the rate of 1 pH unit/min.
2. The waste-stream flow rate varied between 6,000 and 12,000 gal./min. and could cover the complete range in five minutes.
3. The commercial-grade reagents used for neutralization could vary in strength by several percent.

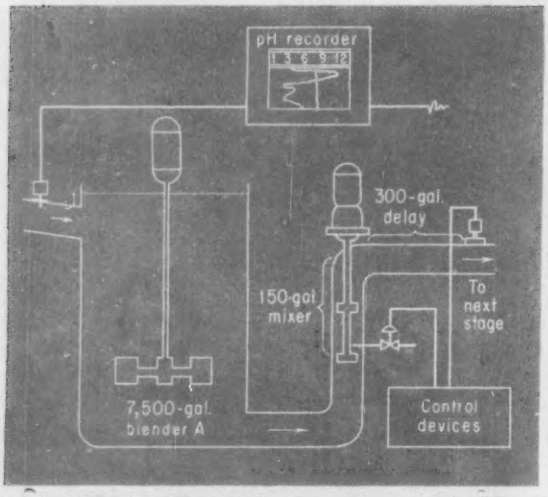
Field also was able to list seven questions that the successful designer of such a system must be able to answer in his final design:

1. How many stages of mixing and reaction are required for most-efficient operation?
2. What are the proper tank sizes?
3. Where should the pH measurements be made?
4. Should closed-loop control be used, or is an open-loop system satisfactory?
5. What is the best valve characteristic to use—linear or characterized? What ranges are best?
6. Could feedforward, adaptive or cascade control be used advantageously in this process?
7. What are the best controller settings to use?

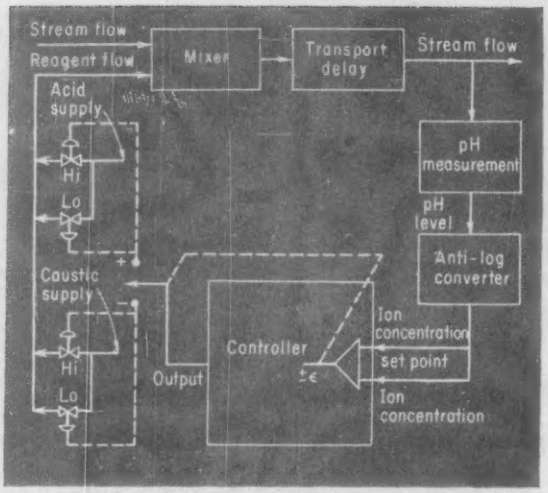
Time spent in the library is possibly the most valuable part of the whole study, since one can often find that all or a large part of the required task has been solved by a previous investigator. Even if the problem is a new one, the engineer usually obtains leads from the literature that greatly reduce the subsequent mathematical analysis and computer work.

## Development of Possible System

Fig. 8 presents part of the process system finally developed. Blender A, first of three similar units, was placed ahead of the first reagent addition to smooth out some of the sharper fluctuations in waste stream concentration and thus ease the burden on the first-




**Schematic** for a pH neutralization system study.—(Fig. 8)




**Block** diagram of control for each blending stage.—(Fig. 9)

stage mixer-reactor. The mixers, following blenders A and B, were made as small as possible to give the fastest practical response. The delay volume after each mixer permitted the flow to quiet after leaving the mixer to allow more accurate pH measurement. The delay volume also had to be as small as practical because of destabilizing effect of dead time on control.

Beaause of the tremendous variations of required neutralizing-reagent flow caused by the wide range of entrance pH values and the possible 2-to-1 fluctuation in waste-stream flow, one valve size would have been incapable of accurate flow control over the range required. Accordingly, a split-range system of two valves per reagent, per section, was installed.

Fig. 9 gives a block diagram of the resulting control system for each stage. A comparison of flow range of the large valve in the rough stage (following blender A) with the small valve in the finishing stage (following blender B) shows an over-all variation of 45,000-to-1 in the control span.

The analog model required for simulating the neutralization system was unique in two respects. First, provision had to be made to allow the analog computer to handle the 12 decades of possible variation in ion concentration with the 3 to 4 decades of voltage available in the computer. Second, all process time constants and dead times had to be made variable because of the fluctuations in stream flow rates.

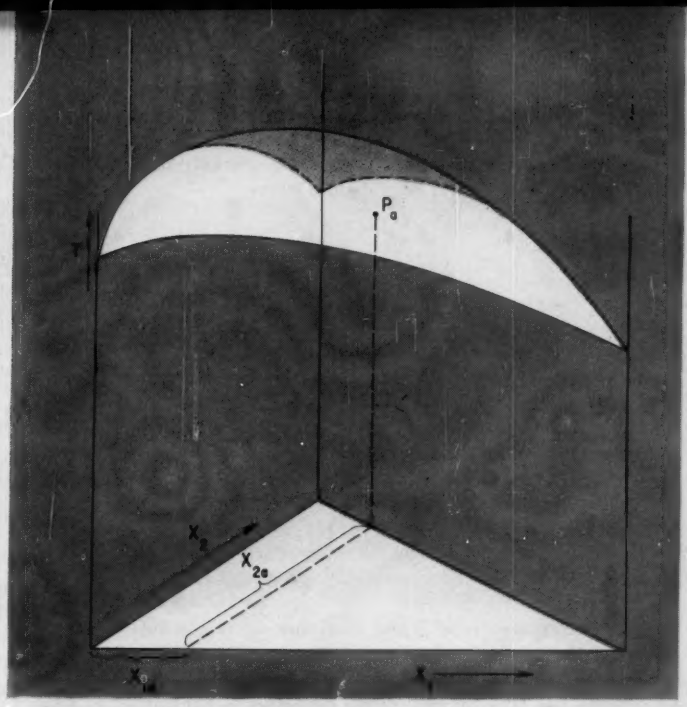
The first was handled by special nonlinear functions on the analog computer and by using a different scaling in each section of the process being simulated. The second provision was handled by making the feedback potentiometer a servomultiplier cup whose shaft was driven by the process stream flow rate. (As flow was varied, the time constant of the simulated process varied with that of the real process.)

From his study of the process on the analog computer, Field found that the optimum controller constants for the process at low flow rates was a 260% proportional band, a reset rate of 32.5 repeats/min. and a derivative rate of 0.054 min. In answer to the original seven questions raised in the problem statements, he proposed the following:

1. Two stages were necessary and sufficient.
2. The tank size in Fig. 8 proved satisfactory in the simulation.
3. pH measurements should be made as close as possible after the mixing-reactor stage. Some settling time must be allowed, however, to assure accurate measurement.
4. Because of reagent variations, open-loop control was impossible; closed-loop control is required.
5. Because a linear process was assumed, linear valves proved satisfactory. Dual-range valves were necessary as explained above.
6. Further computer studies showed that an adaptive control concept would give an additional 4-to-1 control range increase.
7. Optimum controller settings were found.

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**Here are two methods for slide-rule or digital-computer calculation. They use experimental data from binary vapor-liquid equilibrium relations and show you....**

# How to Predict Ternary Azeotropes

IMRICH KLEIN, *Chemical Engineer, Richmond, Va.*

To predict the ternary azeotrope, it is possible to use the data from the three binary liquid-vapor equilibrium diagrams. In the method suggested here, an analytical equation depicting a second-order surface is fitted by the least-squares method to the experimental points of the vapor curve for the binary vapor-liquid equilibrium diagrams. The maximum or minimum value of this equation represents the ternary azeotrope. Because of its length, computations for this method are best suited for programming on a digital computer.

It is also possible to use a shorter and simpler method that is suitable for slide-rule computations. This technique requires: two binary azeotropes, one point on the third binary phase diagram and the boiling points of the three pure components. The ternary azeotrope so computed is remarkably close to the experimentally obtained value.

Binary liquid-vapor equilibrium diagrams plotted as temperature against composition contain two curves. The lower curve represents the initial boiling points of the binary mixtures as function of composition, whereas the upper curve represents the final boiling points of the mixtures.

A ternary liquid-vapor phase diagram can be represented in three-dimensional space. Two dimensions are used to represent two of the three components and the third dimension represents the temperature, as shown in the diagram.

The two curves in the binary diagram correspond to two surfaces in the ternary diagram. The upper surface represents the vapor composition at equilibrium and is best suited to predict the ternary azeotrope. This surface can be closely approximated by an analytical equation of the second order, having the following form:

$$T = C_{20} X_1^2 + C_{11} X_1 X_2 + C_{02} X_2^2 + C_{10} X_1 + C_{01} X_2 + C_{00} \quad (1)$$

where:

$T$ Temperature (dew point of mixture).
$X_1$ Mole fraction of one component.
$X_2$ Mole fraction of second component.
$C_{mn}$ Coefficients.
$m$ Exponent of $X_1$.
$n$ Exponent of $X_2$.

## Examine Method for Slide-Rule Computation

If only the boiling points of the three pure components and boiling points and compositions of the three binary azeotropes are available, we can use the mathematical approach described below.

The conditions for the three binary azeotropes are identical to those of the maximum or minimum points of a curve that are:

$(dT/dX_1) = 0$ when $X_2 = 0$

$(dT/dX_2) = 0$ when $X_1 = 0$

$(dT/dX_1) = 0$ when $X_3 = 0$. Hence, $X_1 + X_2 = 1$

By applying the three conditions to Eq. (1), we

obtain the following equations that relate the extreme points of the vapor-liquid equilibrium curves:

$$2C_{20}(X_1)_B + C_{10} = 0 \quad (2)$$

$$2C_{02}(X_2)_B + C_{01} = 0 \quad (3)$$

$$2(C_{20} - C_{11} + C_{02})(X_1')_B + (C_{11} - 2C_{02} + C_{10} - C_{01}) = 0 \quad (4)$$

Subscript $B$ refers to the binary azeotropes and $X_1'$ to the binary system in which $X_3 = 0$. We can get better results by replacing Eq. (4) by an equation that is obtained after substituting the coordinates of the experimental point of the third binary diagram into Eq. (1).

By substituting the boiling points of the three pure components into Eq. 1, we get three more equations. Solving these three equations simultaneously with Eqs. (2), (3) and (4), we can easily find all six coefficients for Eq. (1).

The ternary azeotrope is the maximum or minimum point of the surface represented by Eq. (1) whose coefficients are calculated as previously described. The conditions for this maximum or minimum point are $(\partial T/\partial X_1) = 0$ and $(\partial T/\partial X_2) = 0$. Applying these conditions to Eq. (1), we get the following equations:

$$2C_{20}X_{1a} + C_{11}X_{2a} = -C_{10} \quad (5)$$

$$C_{11}X_{1a} + 2C_{02}X_{2a} = -C_{01} \quad (6)$$

Solving Eqs. (5) and (6) simultaneously for $X_{1a}$ and $X_{2a}$ gives the composition of the ternary azeotrope. By inserting these values into Eq. (1), we get the boiling point $T_a$ of the ternary azeotrope. The ternary azeotrope $P_a$ is completely defined by determining the values for $X_{1a}$, $X_{2a}$ and $T_a$.

This method was tested on a ternary azeotrope for the system (carbon disulfide-methanol-ethyl bromide). The predicted azeotrope compares with the experimentally obtained point as shown in the following table:

| | Composition | |
|---|---|---|
| | Calculated Mole % | Experimental[1, 2] Mole % |
| Carbon disulfide | 40.4 | 40.5 |
| Methanol | 19.4 | 24.1 |
| Ethyl bromide | 40.2 | 35.4 |

The preceding method for predicting the ternary azeotrope is based on the assumption that the surface can be represented by a quadratic equation. This can be seen from the shape of the binary liquid-vapor phase diagrams by visual inspection. If sufficient data are not available for this test, it is at least necessary to know that the three binary azeotropes are all minimums or all maximums.

## Average Values Give More Accurate Results

The six coefficients of Eq. (1) can be more accurately evaluated from the available experimental points of the three binary equilibrium diagrams. After applying the least-squares technique to Eq. (1), we get the following simultaneous equations:

$$C_{20}(X_1^4) + C_{11}(X_1^3 X_2) + C_{02}(X_1^2 X_2^2) + C_{10}(X_1^3) + C_{01}(X_1^2 X_2) + C_{00}(X_1^2) = (TX_1^2) \quad (7)$$

$$C_{20}(X_1^3 X_2) + C_{11}(X_1^2 X_2^2) + C_{02}(X_1 X_2^3) + C_{10}(X_1^2 X_2) + C_{01}(X_1 X_2^2) + C_{00}(X_1 X_2) = (TX_1 X_2) \quad (8)$$

$$C_{20}(X_1^2 X_2^2) + C_{11}(X_1 X_2^3) + C_{02}(X_2^4) + C_{10}(X_1 X_2^2) + C_{01}(X_2^3) + C_{00}(X_2^2) = (TX_2^2) \quad (9)$$

$$C_{20}(X_1^2) + C_{11}(X_1^2 X_2) + C_{02}(X_1 X_2^2) + C_{10}(X_1^2) + C_{01}(X_1 X_2) + C_{00}(X_1) = (TX_1) \quad (10)$$

$$C_{20}(X_1^2 X_2) + C_{11}(X_1 X_2^2) + C_{02}(X_2^3) + C_{10}(X_1 X_2) + C_{01}(X_2^2) + C_{00}(X_2) = (TX_2) \quad (11)$$

$$C_{20}(X_1^2) + C_{11}(X_1 X_2) + C_{02}(X_2^2) + C_{10}(X_1) + C_{01}(X_2) + C_{00} = (T) \quad (12)$$

where the quantities in parentheses represent average values for the terms shown.

The six coefficients of Eq. (1) can be obtained by simultaneously solving Eqs. (7) through (12) where the coefficients $C_{mn}$ are unknown and the terms in parentheses are obtained from the binary points. Since the described method is an interpolation, the precision by which the equation will represent the surface is limited. It can be improved by including experimentally obtained ternary points into the computation. The above method can be easily programmed for the IBM 650 digital computer and the running time will not exceed one minute.

## Do Components Have Limited Solubility?

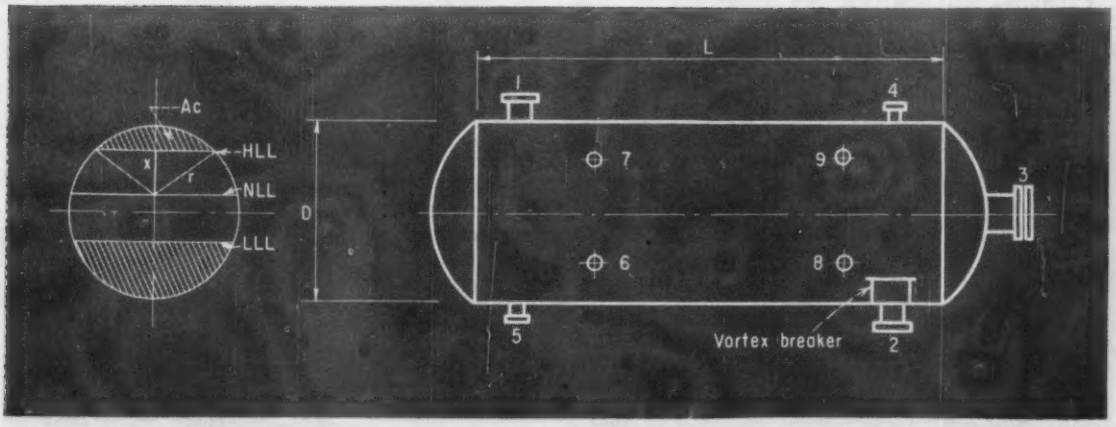
It is important to remember that all three components should be soluble in each other in all proportions because only for this case can one surface represent all the boiling points. If all three components are mutually insoluble, or if the solubility range is very limited, one equation for each surface corresponding to each liquid phase must be used. The method is analogous to that developed for solid-liquid equilibria[3] and can be adopted without any change.


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## Meet the Author


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# Process Design of a Distillation Reflux Drum

S. H. FRIEDMAN, J. W. MURTHA
*Bechtel Associates, New York*

*This article is the first of several process design notes prepared by the same authors. The articles will present one approach to problems frequently encountered by chemical engineers engaged in process design. The methods have proved themselves in practice but, because of their empirical nature, leave latitude for adjustment.—Editor.*

This article will present a method for the process design of a distillation reflux drum under the simplest condition—liquid present but no vapor. Later articles will consider those cases where vapor and vapor with water are present.

In this case, liquid holdup is the major factor in determining the diameter of the reflux drum. The factors that, in turn, determine the amount of holdup required are:

- Maintenance of an even reflux rate to the distillation column to avoid an upset in equilibrium.
- Maintenance of a steady product drawoff rate, particularly if product is fed to another unit.
- Maintenance of a minimum holdup so that the controlled variable output to the column instrumentation is steady.

What is meant by holdup? For our purposes, we will define it as the volume between low liquid level LLL and normal liquid level NLL. The following volumes can be used to determine the holdup between LLL and NLL: 2 or 3 min. on reflux plus 5 min. on product; 8 to 10 min. on total overhead vapor condensed. Generally, the larger of these two is taken.

Having determined the required holdup volume, we next assume a drum diameter for the first trial. The most economical design for pressures above 100 to 150 psig. is one in which the L/D (length/diameter) ratio is from 3 to 5 to 1. For the first trial, assume $L = 3D$. The gross volume, exclusive of the heads is $\pi D^3L/4$. From these two expressions, the relationship $D = 0.75\sqrt[3]{V}$ is derived, where $V$ is the gross volume in cu. ft.

Now, it is necessary to check the assumed diameter. First, assume a value for the distance from the bottom of the drum to LLL. This distance should be 8 to 12 in. if the diameter is more than 24 in. Use shorter distances for smaller diameters or decrease L/D below 3/1. Next, assume a value for the distance from HLL (high liquid level) to the top of the drum. This should be 6 to 8 in.

Find the areas cut off by the two chords, LLL and HLL. These areas are conveniently found from the mathematical tables, J. H. Perry, "Chemical Engineers' Handbook," 3rd ed., page 31, McGraw-Hill, 1950. The areas can also be calculated from the equation:

$$A_c = \frac{\pi r^2}{2} - \left[x\sqrt{r^2 - x^2} + r^2 \sin^{-1}\left(\frac{x}{r}\right)\right]$$

Refer to the sketch for an explanation of the terms in the equation. The equation is an integration of the area $A_c$ and must be solved by trial and error. The angle $x/r$ must be expressed in radians.

Subtract the total of these two segmental areas from the total cross-sectional area of the drum. Multiply the remaining area by the assumed length to give the volume contained between LLL and HLL. This volume should be equal to or

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**How to Enter Contest**—Any reader (except a McGraw-Hill employee) may submit as many contest entries as he wishes. Acceptable material must be previously unpublished and should be short, preferably not over 500 words, but illustrated if possible. Acceptable nonwinning articles will be published at space rates ($10 minimum).

Articles should interest chemical engineers in development, design or production. They may deal with useful methods, data, calculations. Address Plant & Process Design Notebooks, *Chemical Engineering*, 330 W. 42 St., New York 36, N. Y.

slightly greater than twice the holdup volume. If it is less, a larger diameter must be assumed and recalculated.

By similar calculation of areas, it is possible to determine the position of NLL with respect to the top or bottom of the drum. Remember that the holdup volume (between LLL and NLL) is equal to ½ the volume between LLL and HLL.

The final step of the process design is to set the number, size and location of nozzles. The sketch shows the location of nozzles usually required on a reflux drum. Size depends on the flowrates to and from the drum. The nozzles are as follows:

1. Condensed overhead.
2. Drawoff.
3. Manhole, 18-in. diameter. If $D$ is less than 3 ft., use handholes.
4. Noncondensable vent.
5. Drain.

6 & 7. Taps for level controller.

8 & 9. Taps for gage glass.

Nozzles 6, 7, 8 and 9 can also be located on the top and side of the drum.

At this point, the process design is complete and the drum is ready for structural design.

# SUM-OF-YEARS DEPRECIATION

JAVIER F. KUONG

*Process Engineer, Atlas Powder Co., Wilmington, Del.*

In estimating annual depreciation for equipment, three methods are in common use—straight-line, declining-balance and sum-of-the-years-digits depreciation. The sum-of-the-years-digits method has the advantage of permitting the depreciable value to decrease to either zero or a given scrap value at the end of the estimated service life.

In this method of depreciation, the annual depreciation is based on the number of years of service remaining each year and on the sum of the arithmetic series of the years from 1 to $N$. The depreciation charge each year is calculated by dividing the number of remaining service years by the sum of the digits corresponding to the total service years and then multiplying this ratio by the total depreciable asset value.

The nomograph was constructed from the equation:

$$D = \frac{N_D}{1+2+3+\ldots N} V$$

$$= \frac{N_D}{\sum_{1}^{N} N_i} V$$

where:

$D$ is the annual depreciation by sum-of-the-years-digits from 1 to $N$ in dollars.

$\sum_{1}^{N} N_i = 1 + 2 + 3 + \ldots N$, sum of the years digits from 1 to $N$.

$N$ is the number of years of service of the depreciable item.

$N_D$ is the number of years of serv-

## TEST YOUR CEQ*

BY ROBERT LEMLICH

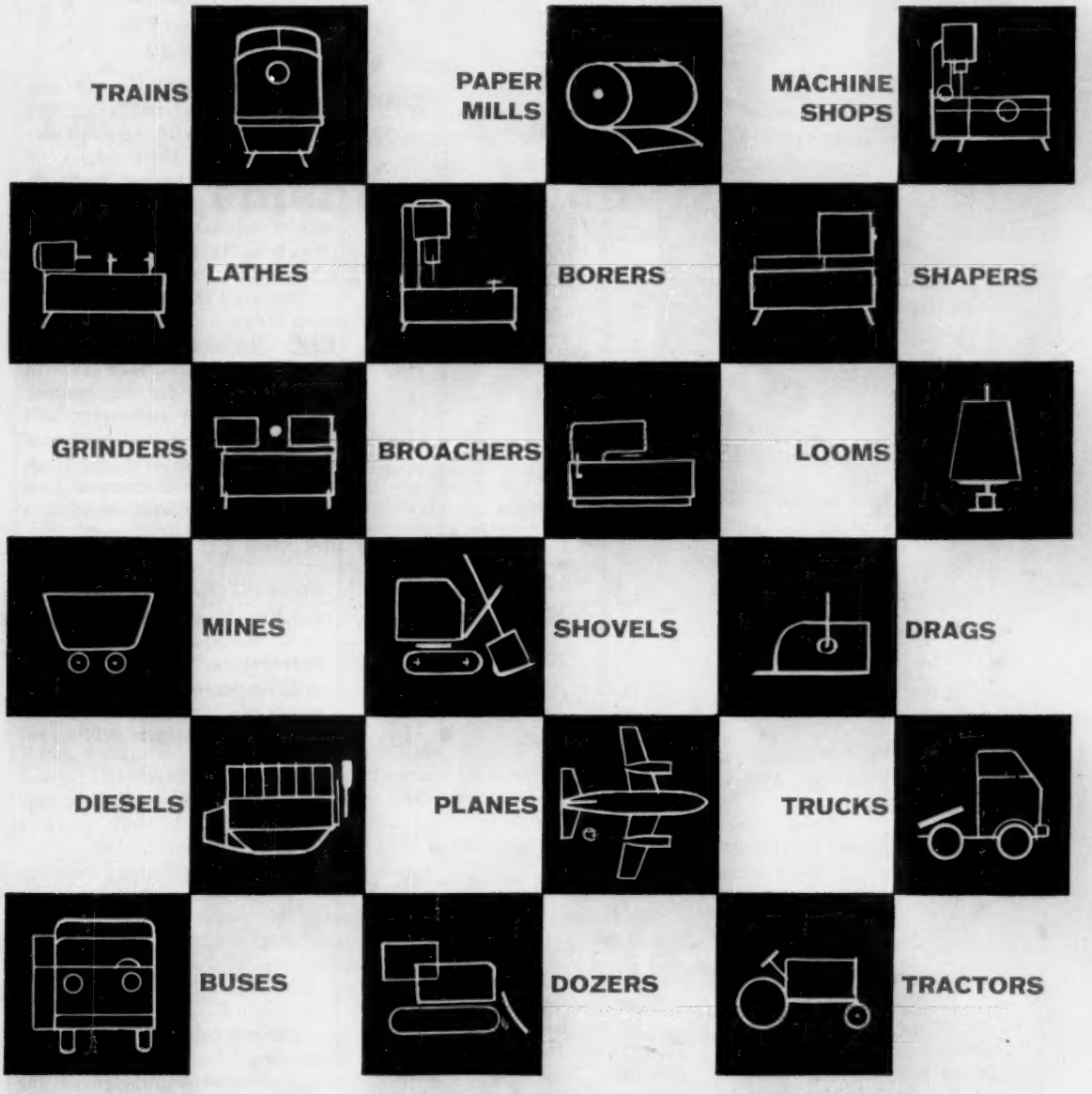



It is the year 2000 and your wife is worried over her favorite grandson. He is a space cadet stationed in a satellite that is in circular orbit around the sun. The satellite has negligible internal heat sources but, by spinning on its own axis, maintains a comfortable 70 F. inside by virtue of solar radiation. News has reached you and your wife, however, that the satellite is to be moved by the mother ship to a new circular orbit 30% more distant from the sun. Your wife fears that the new steady-state temperature will be too cold for your grandson's comfort. Is her concern over the matter justified?

* Chemical Engineering Quotient

*For the answer, see page 238.*

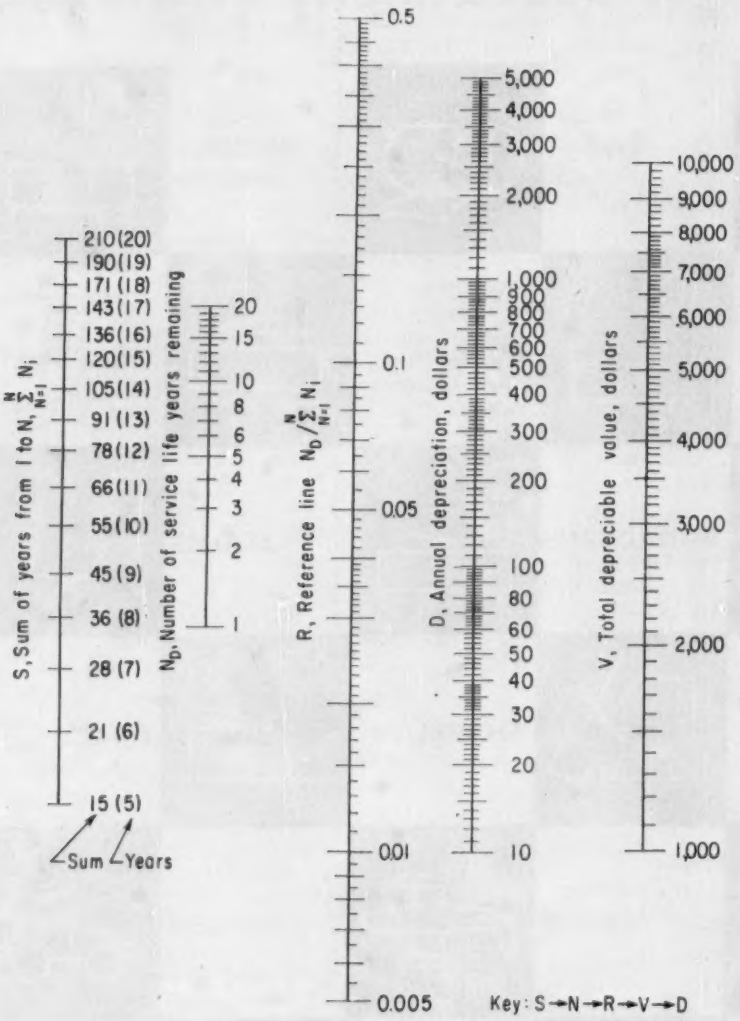
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ice remaining each year, $N - 0$, $N - 1, \ldots N - (N - 1)$, for the first, second, etc., up to the last year of depreciation, respectively.

$V$ is the total depreciable value, usually the total initial value of the item minus its salvage value, if any, in dollars.

▶ **Example**—The value of a piece of equipment is \$5,200. Its salvage value at the end of 10 years is estimated to be \$200. What is the annual depreciation for the first, second and third years?

The depreciable amount is \$5,200 − \$200 = \$5,000.

The first, second and third years correspond to 10, 9 and 8 years of remaining service life, respectively.

Align 55 (sum of the digits from 1 to 10) on the left scale with $N =$ 10 yr. (for the first year of depreciation, $N - 0 = N$) until the reference line is intersected. With the point of intersection as a pivot, align this point with \$5,000 on the $V$ scale at the right. Read $D =$ \$910 as the annual depreciation for the first year. Repeat this procedure for $N = 9$ and $N = 8$ and obtain $D = 820$ and 720, respectively. The corresponding calculated values of $D$ are \$910, \$818 and \$723.

The limited range of the $V$ scale does not prevent the handling of larger values.

***Answer to "Test Your CEQ," page 236***

The satellite and the sun may be considered of negligible size in comparison with the great distance between them. Also, at steady state, the net heat received by the satellite from the sun is re-radiated to outer space, which is, in effect, at absolute zero.

The sun's temperature and dimensions are constant. The satellite's dimensions are constant. For the satellite surface (as with most surfaces for engineering purposes), the emissivity will not change much with moderate variation in temperature. Then, by the Stefan-Boltzmann Law and the Inverse-Square Law,

$$q \propto \frac{1}{R^2} \propto T^4 \qquad (1)$$

where $q$ is the rate of heat transfer, Btu./hr.; $R$ is the radius of orbit, miles; $T$ is the satellite temperature, °R. Also, $t$ is the satellite temperature, °F.; and subscripts 1 and 2 refer to the smaller and larger orbits, respectively.

$$T \propto \frac{1}{\sqrt{R}} \qquad (2)$$

or

$$\frac{T_2}{T_1} = \sqrt{\frac{R_1}{R_2}} \qquad (3)$$

or

$$\frac{460 + t_2}{460 + 70} = \sqrt{\frac{1}{1.3}}$$

or $t_2 = 5$ F.

He had better be wearing his woolies!

Note that knowledge of the sun's temperature is not required for the solution. Note, also, that the assumption of constant emissivity is justified by the comparatively small change in absolute temperature.

The problem can also be solved in more detailed fashion, using geometric factors. The resulting temperature will, of course, be the same.



# The Management Function Of the Engineer in Industry

***More and more chemical engineers today are being assigned management responsibility in the process industries. That's why you must be ready not only for technical innovation but for innovation in methods of handling people as well.***

HOWARD S. BUNN, *Union Carbide Corp.*

When I returned to the Lehigh campus last June, I heard Allan Nevins, the eminent historian of Columbia Univ., talk about, "Born Free but Accepting Chains." He told the graduating class:

"The central indictment of the world of large-scale business into which young men enter today is that it places a standardizing and leveling weight upon the people whom it absorbs. It increases the degree of uniformity and conformity, of passivity and conservatism in American life, and enlarges the world of authoritarianism. It does this not in one way but in many."

Referring to large business organizations as "economic concentrations," Nevins also told the graduates:

"They pay lip service to individualism and say a great deal about the value of leaders and specially brilliant men. But actually they prefer someone who keeps close to the center of the boat. They train men to think as the boss thinks, to respect red tape and to refuse to take any chance that might turn out to be a mistake.

"Group harmony, in this system, is the important goal; and where authoritarian pressures are heaviest, the American corporate bureaucracy can look unpleasantly like the Russian collectivist bureaucracy."

These are strong words.

I don't know what effect they had on the graduating seniors, but I am becoming deeply concerned about the tendency of influential speakers and writers to lambaste American industry because it's big and because it's organized.

I don't think either of these facts necessarily means that American corporations resemble "Russian collectivist bureaucracies," and I do not believe that young men with good minds view industrial corporations in that light.

## A Living Organism, Not a Mechanism

Allow me to express my concern over the growing notion that industry wants only conformists and that large corporations are inert monsters that stifle individuality and initiative. I feel that nothing could be further from the needs of American industry or from the objectives of its top management.

A corporation is a living organism, not a mechanism. Parts grow old and die. New parts grow and flourish.

No corporation can be a vital force for growth and progress unless men of inquiring mind, stout heart and stubborn persistence are attracted to it.

I am disturbed by these negative implications for I know all American corporations are not entirely perfect either. Unfortunately, as organizations become larger and more complex, the tendencies toward conformity and submergence of the individual increase.

Where this happens, however, I believe it comes

about largely because of apathy on the part of managers and subordinates alike, not because of a conscious desire on the part of management. Rather than argue about the degree of conformity, let's examine some principles of management that, in my opinion, insure against the conditions that Nevins and others see in our industrial organizations.

Our studies within Union Carbide offer convincing evidence that a major part of the problem is related to the fact that in the last 50 years the composition of the human resources of industry has changed significantly, while our principles of motivation, human organization and management have really changed very little.

Since you are part of the change in the nature of this human resource, I think you'll be interested in some of the findings.

### The Consequence of Innovation

One of these studies, "Manpower and Innovation in American Industry," was completed last year. It points out, for example, that in 1910, professional and related people accounted for less than 1% of the work force in manufacturing industries of the U.S. By 1957, the professionals had risen to more than 7%.

Of even greater interest to you is the fact that the occupations of engineer and chemist have been growing at an unusually rapid rate. By 1950, they accounted for 1.11% of the civilian work force. Between 1952 and 1957, employment of professional, technical and kindred workers in manufacturing increased 45%, and rose 27% from 1955 to 1957.

Key conclusion of this report is that this greater employment of high-talent manpower is largely the consequence of innovation, not really the result of Parkinson's Law.

Even, more significant, however, may be the conclusion that future economic growth depends to a great extent on even more spectacular expansion in the employment of high-talent manpower. And to be more effective, high-talent people will need to be motivated by entirely different concepts of industrial environment, organization, incentives and relations between managers and the managed.

Certainly the character of our jobs is changing rapidly. More and more of them are "idea" jobs requiring restless inventive minds.

Traditional management practices designed to deal with routine jobs and ordinary assembly lines seem to be neither appropriate nor effective for our present-day situation. Organizational principles that are directed at narrowing and specializing all jobs do not meet our needs for breadth and flexibility.

Chemical engineers, for example, can no longer be content with a narrow professional orientation. Nor can engineering management afford to encourage such a viewpoint. The importance of the engineer—and specifically the chemical engineer—in the management function can be illustrated in our own company.

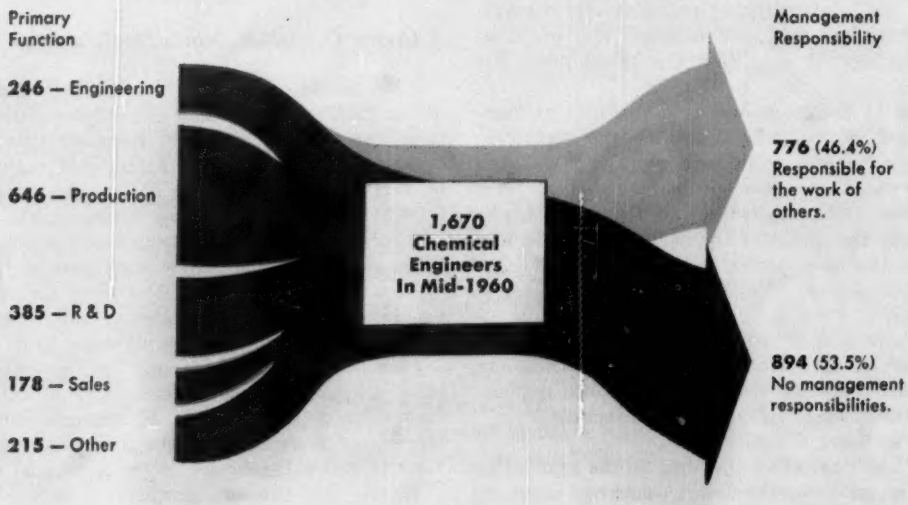
### 46.4% Are in the Management Function

As of mid-1960, there were 1,670 chemical engineers in Union Carbide: 246 in engineering; 385 in research and development; 646 in production; 178 in sales; and 215 in other functions.

Simply taking that portion of the management function that involves responsibility for the work of others, 776 of these engineers, or 46.4%, are involved in the management function of the corporation.

When I graduated as a chemical engineer, the emphasis in the curriculum was on practical engineering with equipment design as a prominent portion.

**Chemical engineers in all functions at Union Carbide**



# Progress Report...

—2-Ethylhexyl acrylate
—UCON Rubber lubricant 77
—Propylene Glycol

## 2-Ethylhexyl acrylate—plasticizing comonomer

Many important advantages for vinyl acetate copolymers are offered by CARBIDE's 2-ethylhexyl acrylate. Its high plasticizing efficiency permits the use of as little as 10 to 15 per cent to give the same flexibility provided by twice the amount of competitive comonomers.

Since it polymerizes at a greater rate than competitive comonomers, 2-ethylhexyl acrylate can increase the throughput per kettle each working shift.

Use in the field has confirmed laboratory findings that 2-ethylhexyl acrylate improves low-temperature coalescing properties of latex paints and produces films with good water resistance and outstanding durability.

One of the distinctive pluses of 2-ethylhexyl acrylate is the opportunity it affords manufacturers to tie-in product advertising with the current widespread public acceptance of the term *Acrylic*.

For information on the many useful and profitable applications of 2-ethylhexyl acrylate, call your CARBIDE Technical Representative or use the coupon below.

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UCON 77, a water-insoluble polyalkylene glycol derivative, can be used as a Bag-o-Matic and bladder lubricant in foam mold-release agents, and in many other rubber mold-release applications.

Clean break-away is provided because no gummy residue is formed on tire bags, bladders, or mold surfaces at vulcanizing temperatures. Mold-cleaning frequency is substantially reduced.

UCON 77 also has a low solvent and swelling effect on most natural and synthetic rubber compounds—including



butyl rubber—thereby adding greatly to bladder life.

UCON Rubber Lubricant 77 is available at competitive prices and in commercial quantities. For specifications and prices, call the Technical Representative at your nearest CARBIDE office. For a copy of a Technical Information Bulletin on UCON 77, use the coupon below.

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***Our future economic growth depends to a great extent on spectacular expansion in the employment of high-talent manpower. The importance of the chemical engineer in the managment function will become increasingly evident.***

In the intervening years, the emphasis has shifted more and more to the analytical, theoretical aspects.

The "mass points" of usage for chemical engineers have similarly shifted from design to production and from production to research and development. 46% of he chemical engineers hired at Union Carbide last year went to research and development. Only 29% were assigned to production and 16% to engineering.

### Innovation Is the Lifeblood of Industry

My point is that technological innovation is the lifeblood of industry and of prime concern to engineers. The danger is that as we become entranced with our ability to produce technological improvements, we tend to forget that all such improvements spring from the creative energy and imagination of people.

Engineering management has a real responsibility here. I would be the last to deny that professional and technical competence are of increasing and absolute importance in today's complex industrial picture.

However, we need engineers who are also businessmen, who can evaluate and plan the consequences of their professional work and who can manage the human assets of industrial enterprise in ways that are appropriate to the kinds of minds involved.

In Union Carbide, we have reached the firm conclusion that the growth and health of our business rests on the creative energy of our people, and we are devoting considerable effort to examining how we can best release and guide the creative urge.

This process of self-examination can be rewarding. Throughout industry, many questionable practices and policies have grown up over the years to become "principles of management," simply because managers have never taken the time and effort necessary to examine them and to challenge their validity.

We often act in industry as though people were inherently lazy, stupid, lacking in ambition and indifferent to organizational needs. Actually, people aren't this way by nature.

I would guess that we are lucky if we are able to use as much as 50% of the human talent and energy available to us. Over the years, jobs have become compartmentalized, communications have become strangled and many people have become passive and apathetic because the management climate has frustrated them. They reach the point where they seek release for their creative energies elsewhere.

Good minds are not stimulated by dictatorial procedures nor are they inspired by authoritarian managers. When we fail to realize a good return on our investment in a man, in far too many instances it is because we have not made it possible for him to contribute that which he would be able and eager to contribute under other circumstances.

I believe that people work best when they have an objective—an objective that they have helped to formulate and identify.

I believe that people bring to an organization a desire to achieve, to do a good job. Therefore, it's the responsibility of the manager to encourage and support the individual in his struggle for achievement.

I believe that we must have risk-takers and that risk-taking must be encouraged. Without it, we would have fewer new products and not many new processes. But we don't always win and it's the responsibility of the manager to accept mistakes as part of the learning process. He must, of course, be sure his people learn from their mistakes.

Finally, I believe in leadership management at all levels. A good manager is neither a dictator nor an abdicator. He is an innovator. He is a communicator of information that his organization needs. In short, he takes the lead in creating a management climate in which growth and progress and innovation can flourish.

I believe that such a manager will work hard at the concept of disciplined freedom—freedom with responsibility—that aims at maximum self-control on the part of individuals and a minimum of coercive control on the part of management.

This article is condensed from Mr. Bunn's address to the New York Section of the American Institute of Chemical Engineers at the Chemists' Club, September 15, 1960.

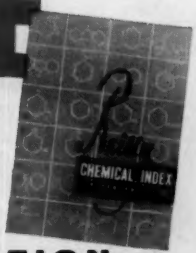
## Meet the Author

HOWARD S. BUNN *is the chemical engineer who now serves as vice-chairman of the board of directors of Union Carbide Corp., in New York. He graduated from Lehigh Univ. in 1922 and worked for several UCC divisions before becoming president of Union Carbide Plastics in 1952. In 1953, he was named a vice president of Union Carbide. Mr. Bunn became executive vice president and a member of the executive committee in 1955, president in 1958 and vice-chairman of the board of directors earlier this year. In recognition of his industrial accomplishments, Lehigh has awarded him the degree of doctor of engineering.*



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# No. 44: ENGINEERING VALUATION

***When determining value of a capital project, it's possible to use many methods of depreciation computation. Here are highlights of three ways.***

JOHN E. HASELBARTH JONAS M. BERK *Houston, Tex.*

Although a common goal of valuation by any of a number of methods is to determine whether a capital venture is feasible, there are times when a choice must be resolved. For example, it may be necessary to decide whether to purchase an operating plant or build a new plant to produce the product.

Such a choice requires determination of present worth of an existing facility. It's necessary to examine the existing plant in light of what it would be exchanged for in a freely negotiated sale, such exchange being the best possible evidence of value or present worth. In the existing facility, value can be measured by comparing the cost of a new, similar facility with the residual value of the old.

When a plant is new, its cost represents its present worth. But for a plant of some age, value must be determined by deducting the accrued depreciation from an estimate of new, replacement cost. Methods to compute depreciation include declining-balance, sum-of-the-digits, straight-line, sinking-fund and present-worth.

For engineering valuation, the last three of these methods are most applicable. Our purpose here is to compare these three in principle; in the next issue of *Chemical Engineering*, we will delineate the calculation necessary to determine present worth.

▶ **Straight-Line Method**—The first of the three depreciation techniques, the straight-line method, assumes that depreciation of the property unit is uniformly distributed over the life of the unit. By definition, therefore, annual depreciation allocation $D$ is:

$$D = (B - V_s)/n = B_d/n$$

where $B$ is the depreciation base, including salvage value, $V_s$ is salvage value at end of probable service life $n$ and $B_d$ is depreciable base. Total depreciation allocation at property age $x$ is $B_d x/n$.

That portion of the depreciation base that is unallocated at age $x$ is

$$B_x = B - (B_d x/n)$$

and substituting the appropriate factors and rearranging

$$B_x = [B_d(n - x)/n] + V_s$$

▶ **Developing a Sinking Fund**—In the second method of computation, the sinking fund, the assumption is that accrued depreciation of a property unit to any date is equal to accumulation in a fictitious equal-annual-year-end-payment sinking fund. At retirement of the unit, total accumulation equals the depreciable value when unit was new.

Accumulation in the sinking fund after $n$ years is

$$S_n = R[(1 + i)^n - 1]/i$$

where $R$ is annual operation return and $i$ is interest rate of one period. Accumulation after $x$ years is found by substituting $x$ for $n$ in this expression. And since after $n$ years, the sinking fund allocation must equal the depreciable base,

$$R = B_d i/[(1 + i)^n - 1]$$

The accumulation in the sinking fund at the end of $x$ years can be expressed by

$$S_x = B_d[(1 + i)^x - 1]/[(1 + i)^n - 1]$$

And the unallocated base, representing value at age $x$ of a property unit depreciated by the sinking fund method, equals the depreciable base new, minus accumulation in the sinking fund, plus the salvage value.

$$B_x = B_d[(1 + i)^n - (1 + i)^x]/[(1 + i)^n - 1] + V_s$$

▶ **Principle of Present Worth**—The final method considered here, present worth, establishes value by looking into the future, rather than reviewing the past.

Value of any income-producing property at any given period in its expected service life is the total operational return to be expected during its remaining service life. This return must include the depreciation allowance and a reasonable profit on the unallocated investment base. Present value of a future service is less than that of a present service.

$$B = B_d + V_s = \sum_{m=1}^{n} R_m/(1 + r)^m + V_s/(1 + r)^n$$

After substituting the uniform operation return $R$ and multiplying by $(1 + r)$, this expression reduces to

$$R = B_d[r(1 + r)^n]/[(1 + r)^n - 1] + rV_s$$

which is the equivalent uniform annual operation return in terms of depreciable base and salvage value.

This expression for $R$ can be rearranged to produce $B = B_d + V_s = R\,[(1 + r)^n - 1]/[r\,(1 + r)^n] + V_s/(1 + r)^n$ in which the factor that multiplies $R$ is the reciprocal of the capital recovery factor. At age $x$, present value $B_x$ is similar except that exponent $n$ becomes $n - x$. Substitution in this latter expression for $R$, in way shown above, gives a useful formula for present value.

(*To be concluded in the Nov. 28 issue*)



# CORBLIN Diaphragm Compressors enable Southern Oxygen Co. to prevent product waste and contamination

**Oxygen, argon and nitrogen manufactured by the Southern Oxygen Co. are moved in liquid form throughout the country by tank truck. To ensure simple, economical handling of the gas at distribution points, without the danger of contamination, Aminco supplied Corblin diaphragm-type compressors to this company for:**

**1. VAPOR RECOVERY:** At distribution points where liquified atmospheric gases must be stored for long periods of time due to small or intermittent demand, large volumes of gas were previously lost through evaporation (1% of volume in 24 hours, vented to atmosphere through relief valves in the storage vessels).

Corblin compressors are now used to recover this gas and pump it in an uncontaminated state into cylinders.

**2. TRANSFER OF LIQUIFIED GAS:** Liquid from the tank trucks is transferred via Corblin compressors into storage vessels without the need for liquid pumps. Residual vapors are first pumped from storage vessels into tank trucks to pressurize the liquid therein and force it into the storage tank. After transfer of all liquid from the trucks, the valves may be reversed to suck vapor back into the storage vessel.

**3. CONTAMINATION-FREE HANDLING:** Gas is compressed by hydraulically-pulsed metal diaphragms which act as a barrier between gas and hydraulic fluid, and as a gasket to prevent leakage from the compressor. Thus, the gas does not come into contact with lubricants or other contaminating agents, and is delivered at a purity level of 99.9998%.

## CORBLIN A REAL MONEY SAVER!

According to R. L. Swope, Chief Engineer of Southern Oxygen, Corblin Compressors actually pay for themselves in a relatively short period of time through dollars saved in reclaiming formerly-unrecoverable gas, and in the reduction of mileage on company tank trucks.

## SEND FOR BULLETIN 4071—C

Aminco will forward on request this Bulletin describing Corblin diaphragm-type pumps and compressors. Units are available for all types of gases including highly toxic, corrosive and radioactive gas, at pressures to 30,000 p.s.i., and capacities to several hundred s.c.f.m. under certain conditions of operation. Units are also available for pumping all types of liquids.

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*Photo: Courtesy Southern Oxygen Co. shows Corblin Compressor installed in St. Petersburg, Fla. plant. Liquid argon storage tank in background.*




# A Safety Program Is a Full-Time Job

***Successful accident prevention needs management's all-out support and hard work by individual supervisors***

EDWARD ALLEN, *Marsh & McLellan-Cosgrove & Co.*

Most plants have some kind of safety program—if we interpret anything done for the workers' safety as part of a safety program. There is hardly an employer who doesn't recognize the fact that safety of the workmen and accident prevention is good business.

Nearly all employers are quite aware of the increased costs of Workmen's Compensation resulting from higher accident compensation and medical benefits. They are also generally aware of the penalties for serious and willful neglect of plant safety and for violations of government safety orders. They know, too, of credits against insurance to be gained by a safe plant and they should know that injuries to workmen and damage to machinery and equipment through accidents means loss of production and profits.

▶**A Safety Program Is Essential**—A safety program should be carried out with the same fervor as a production program. Steps taken to reduce accidents and injuries will improve the individual worker's habits and work methods to the extent that productivity is automatically improved.

And here lies the difference between an effective program and little or none at all. Unless management realizes that efficient operation and accident prevention go hand-in-hand, you can expect a lot of lip service to the safety program.

Of course, almost any employer will say, and generally mean, that he is vitally interested in safety from the humanitarian standpoint, but until he sees that it is also a way to more efficient operation, he is not convinced.

▶**Spell It Out**—In almost any efficient operation, individual jobs are defined step by step. For an effective safety program, you should also spell it out which means that you should have written safety procedures.

But the program, with procedures spelled out, will still not be as effective as it should be unless it is prefaced by a declaration of company policy signed by the top or a top company executive. In other words, the safety program must have the active backing of top management.

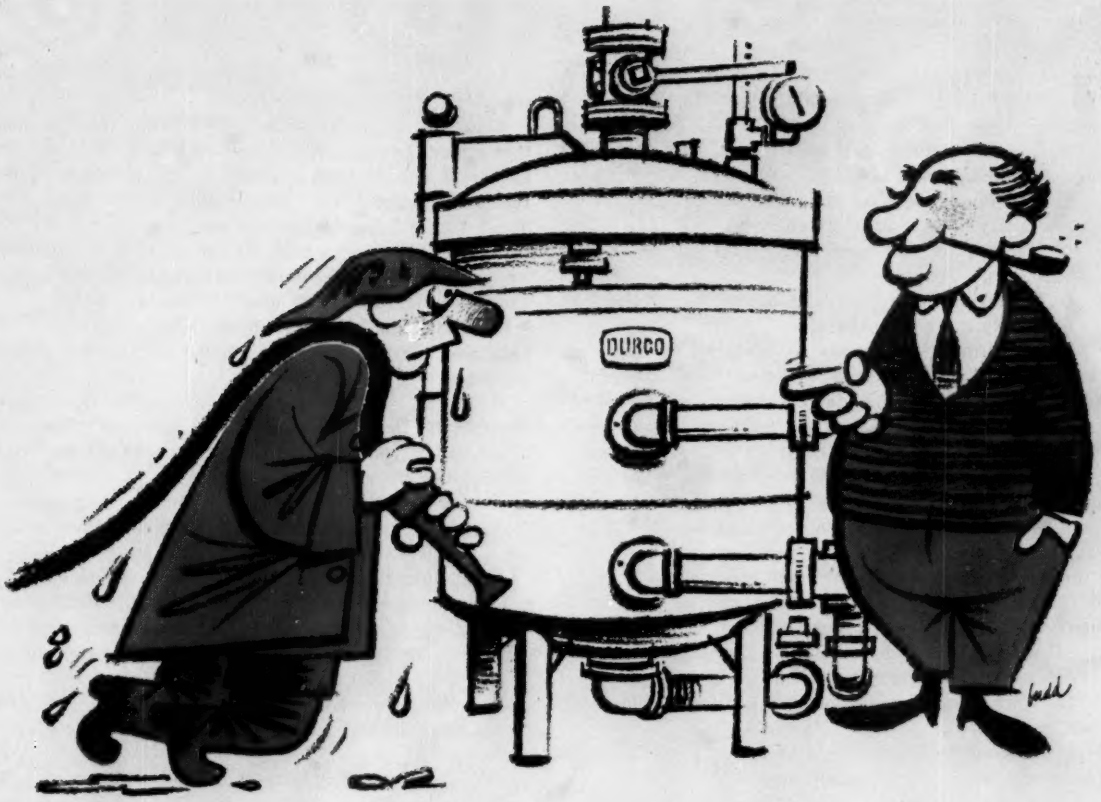
After obtaining this declaration of company policy, begin the written program by outlining the basic principles of accident prevention as follows:

1. Executive interest, support and personal participation.
2. Knowledge of accident facts.
3. Corrective action based on these facts.

The ultimate success of any safety program depends on the safety consciousness of the workers. Management must consider itself largely responsible for developing this attitude. It is essential that management, foremen and supervisors take the initiative in having every job done safely. The average worker's experience is too limited to know what is safe or unsafe under many circumstances.

A supervisor is generally chosen for his knowledge of the job and his ability to get along with people and direct the work being done. He is also expected to do the job with minimum overhead expense. Accidents and injuries are job interruptions, or profit leaks, and unless a supervisor knows something about accident prevention and does something about it, he is not doing a complete job.

Faulty performances that result in injuries to




# ...HANG UP THE HOSE, HENRY!

**This filter sluices with the lid on.**

Durco-Enzinger engineers have developed automatic sluicing to handle any filter cake—even the thin, slimy ones.
**Oscillating sluice**—a solid jet stream moves back and forth across the face of each leaf.
**Rotosluice**—for horizontal tank filters. The sluice jet rotates through 360°, and a screw conveyer removes the cake from the tank.
**Traveling sluice**—designed for the most difficult cakes. High pressure sprays move down the face of each leaf.
**Hydrojet sluice**—permanently positioned spray nozzles in the cover sluice the entire surface of each leaf. Coupled with an air sparger this provides the simplest method of handling average sluicing jobs.

Contact your local Durco sales engineer or write for informative Bulletin EF/2a.

DURCO
CORROSION RESISTING ALLOYS & EQUIPMENT

ENZINGER DIVISION

**THE DURIRON COMPANY, INC.,** Dayton, Ohio / Filters • Valves • Pumps • Process Equipment

employees are the same factors that industry has long recognized as responsible for waste. Prominent among these factors are:

1. Improper and rough handling of raw materials and finished products.
2. Improper use and maintenance of tools.
3. Faulty operation of machinery.
4. Neglect in the care and maintenance of machines.
5. Deviation from standard operating procedures.
6. Poorly trained workers.

If the supervisor hopes to maintain a high operating efficiency, he must make accident prevention an integral part of his daily activity and he should make use of the fact that the majority of accidents are the result of faulty individual performance.

▶**Duties of a Safety Engineer**—Where a plant has a safety engineer, his duties should generally be outlined in the safety program as follows:

1. Inspect the physical conditions of the buildings, machinery, equipment and other items.
2. Observe unsafe work practices and point them out to supervision for correction.
3. Maintain accident records for presentation to management and supervision.
4. Familiarize himself with State and other safety orders.
5. Review publications and other materials that may aid in safety awareness.
6. Act as secretary or chairman at safety meetings.
7. Check recommendations of insurance companies and other agencies.
8. Check safety bulletin boards for proper changes in posters and bulletins.
9. Investigate accidents and aid supervisors in properly completing their safety report forms.

While the safety engineer must assume definite responsibilities in regard to the accident prevention program, he is not directly responsible for the accident record of the individual departments. This responsibility is that of the foremen and supervisors.

▶**Safety Committees Are Important**—Every safety program should include provision for safety committees and should outline, in writing, the duties of these committees.

Generally, there should be at least two safety committees, a general committee and a workers' committee.

Members of the general safety committee should be department heads and/or key personnel in the departments. Meetings should be held monthly at a specific time and should not last longer than an hour. The agenda should include a review of the previous month's accidents, a review of the minutes or the recommendations of other committees and a discussion of means for improving operations with safety factors given full consideration.

The workers' safety committee should be composed of a workman from each department who is designated by his foreman. Committee members should be changed every three months so that as many may participate as possible.

This committee should make a monthly plant inspection under the guidance of the safety engineer or foreman and should then discuss its findings and make recommendations for improvements, if necessary. Total time of the inspection and meeting should not exceed an hour and a half. If the plant is too large to cover in this time, the committee should be divided for the inspection and meet later for discussion.

▶**Investigation Aids Prevention**—Accident investigation procedures should be spelled out in the safety program.

Every accident involving an injury requiring more than simple first aid, should have a supervisor's report. First aid cases that have a serious injury potential should also have a report.

Reports should include the supervisor's opinion on how the accident occurred and what he thinks can be done to prevent a recurrence.

First aid case histories should be given to each department head every month. These will point up any trend toward potentially more serious injuries and will also call attention to the workmen needing closer supervision.

▶**Include New Employees**—Every new employee should be instructed in the safe performance of his or her work.

Wherever practical, supervisors should not only tell new employees what to do, but should also demonstrate the manner in which the work should be done. Moreover, the supervisor should continue to observe the working practices of new employees until he is sure that they fully understand the job and the hazards.

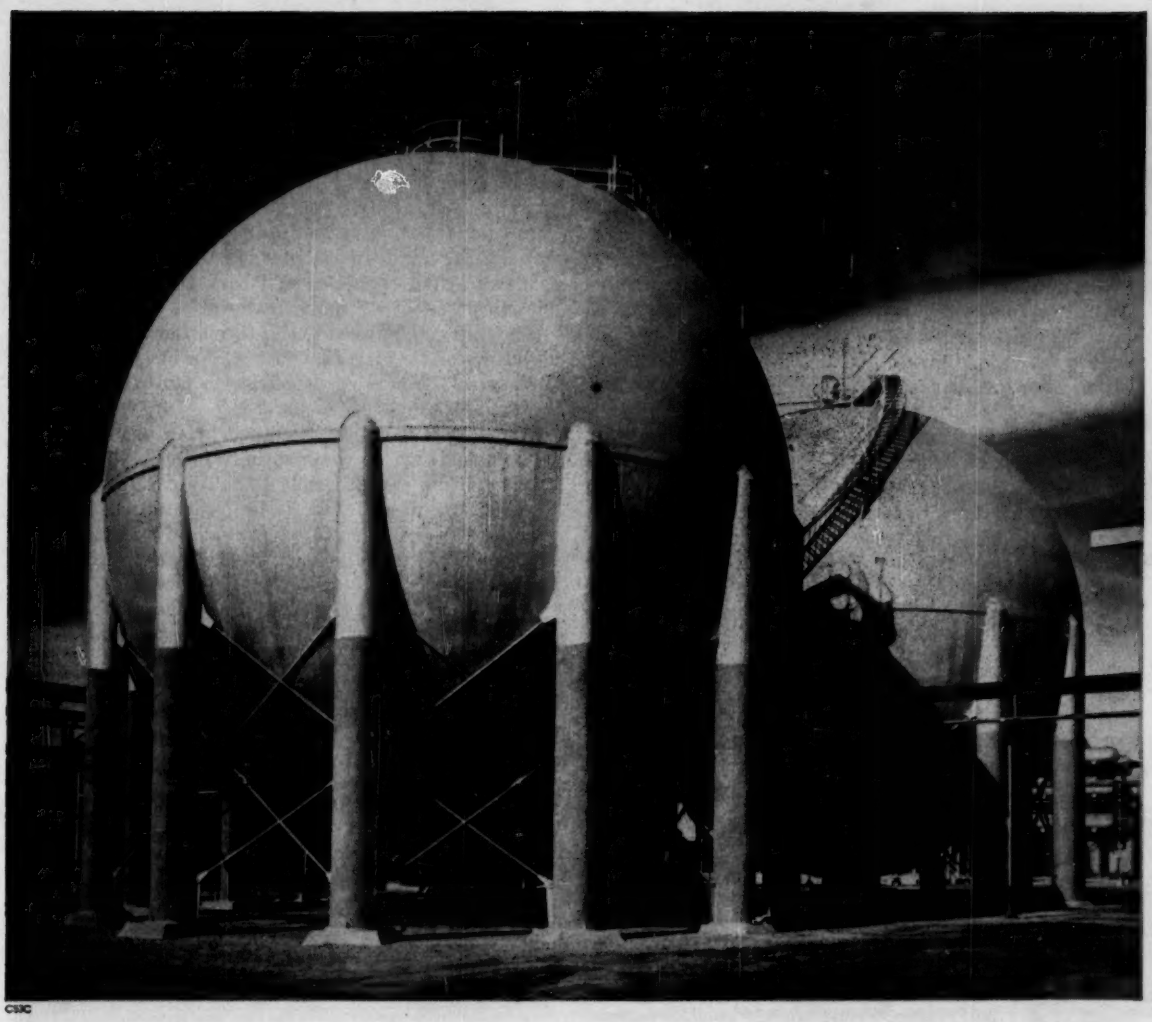
This safety program that we have just outlined can fit into any industry or plant. There are many companies without a written program and some of them get good results. But for over-all, effective and lasting results, a written program is most desirable.

Management must continually obtain information that can be used to keep the program alive. You cannot take it for granted that once you have a program, all you have to do is stand by and let it run. You must continually renew it with fresh, attention-getting material. Management should issue monthly bulletins calling attention to some phase of the safety program. Foremen and supervisors must be told how people in other industries, as well as your own, feel about the values of accident prevention.

Companies with the best safety records are almost invariably those whose chief executives are the sparkplugs of the program, alert to both economic and humane considerations. That many companies are successful in their efforts is indicated by the fact that industrial deaths have been cut nearly 50%, and the frequency and severity of injuries more than 50%, in the last twenty years.

▶**Small Plants Can Afford Safety**—Some people might say that a small plant cannot afford an accident prevention program. I contend that a small plant cannot afford not to have a safety program.

If large corporations with millions of dollars at their



CBIC

# Twin Hortonspheres Store Anhydrous Ammonia

United States Steel Corporation's nitrogen products plant near Provo, Utah, produces chemical fertilizers and industrial acid.

Built at the site of U. S. Steel's Geneva Works, the chemical facility utilizes coke oven gas recovered from steelmaking process to produce anhydrous ammonia. In its liquid form, the product is stored at approximately four times atmospheric pressure in the twin Hortonspheres shown above. Designed, fabricated and erected by CB&I, each structure is 60 ft. in diameter and has a 2,100-ton capacity.

Wherever chemical products are processed or stored, you'll find CB&I *Craftsmanship in Steel*. For details write our nearest office.

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OFFICES AND SUBSIDIARIES IN PRINCIPAL CITIES THROUGHOUT THE WORLD

disposal recognize that they cannot afford accidents, even if considered only from the dollars and cents angle, how can the small operator honestly tell himself that he cannot afford some simple form of safety program for his plant? The fact is that small plants cannot afford even one accident without the expense being reflected in the production costs.

▶**Supervisors Should Be Trained**—Supervisors responsible for getting a job done with a minimum of overhead expense should be trained in accident prevention work. They should discuss the close relationship of accident prevention and efficient operation. They should be able to recognize the different types of accidents and accident causes. And they should know why workers work unsafely.

Some of the reasons why workers commit unsafe acts are that they were unaware that what they did was wrong; they misunderstood the instructions; they did not consider the instruction important; they were not given specific instructions; they did not have proper training; they could not follow instructions because they were the wrong instructions or were badly given; they were handicapped by a physical impairment; they were mentally upset because of financial worries and personal problems; they were prone to recklessness, or day dreaming or were easily distracted; or they disregarded instructions.

All these reasons show the need for improved supervision, better instructions, more frequent checking on performance and better communication between supervisor and worker. They also show the need for more attention to new employee selection, including a better appraisal of attitudes and psychological as well as medical examination.

We can define accident prevention as the process of recognizing accident causes, accidents in the making, unsafe performances and unsafe conditions, and correcting them before the accident occurs.

More consideration should be given to job studies as a source of information on the probable causes of accidents. For example, if a machine is being studied, the observer might ask himself: "What is it that an operator might do to get himself caught between moving parts? How might he come in contact with electricity? What might he do to get himself in a strained or awkward position?"

▶**The Supervisor Is the Key Man**—It might be well to conclude this article by going back to what I think is the key to accident prevention. It is the supervisor.

For years, the supervisor has been called the key man in production as well as in accident prevention. In his production activities, he attends many production meetings to learn all the steps in turning out the best product at minimum cost. He is trained to consider maintenance costs, labor costs and many other items. These training steps are the keys given to the key man in his production activities.

In his accident prevention activities, this key man must also be given a key—the training steps and attention to detail in the accident sequence that helps to minimize accidents and injuries.

If something goes wrong in turning out a product, we first know of it through a spoiled or damaged product. The first we know of an injury is when we hear an outcry or someone tells us that so and so has been hurt.

In similar manner, an injury can be traced back through the accident to the cause of the accident as a spoiled product can be traced back through the production process to the raw material.

An injury is only leading information and properly a matter for the nurse or doctor. We have to go back further in the accident sequence to find the cause if we want to prevent a recurrence.

An accident can only be caused by an unsafe act or unsafe condition or combination of the two. An unsafe condition can generally be taken care of without too much trouble. But in dealing with unsafe acts or practices, we often have to go back still further and find out why people do some of the things that cause accidents.

Until such time as a supervisor can follow an accident sequence as he does a production sequence, he is not doing a complete job. When a supervisor is able to do this, he will find that the steps he takes to correct the factors leading to accidents will be similar to the steps he takes in correcting production errors. He won't have to learn a new language or terminology to tell someone how to operate or conduct himself safely. He will probably use a different approach to certain individuals, but certainly no different than correcting a production error.

I am convinced that the key to more efficient operation is through this two-way, production-accident prevention approach.

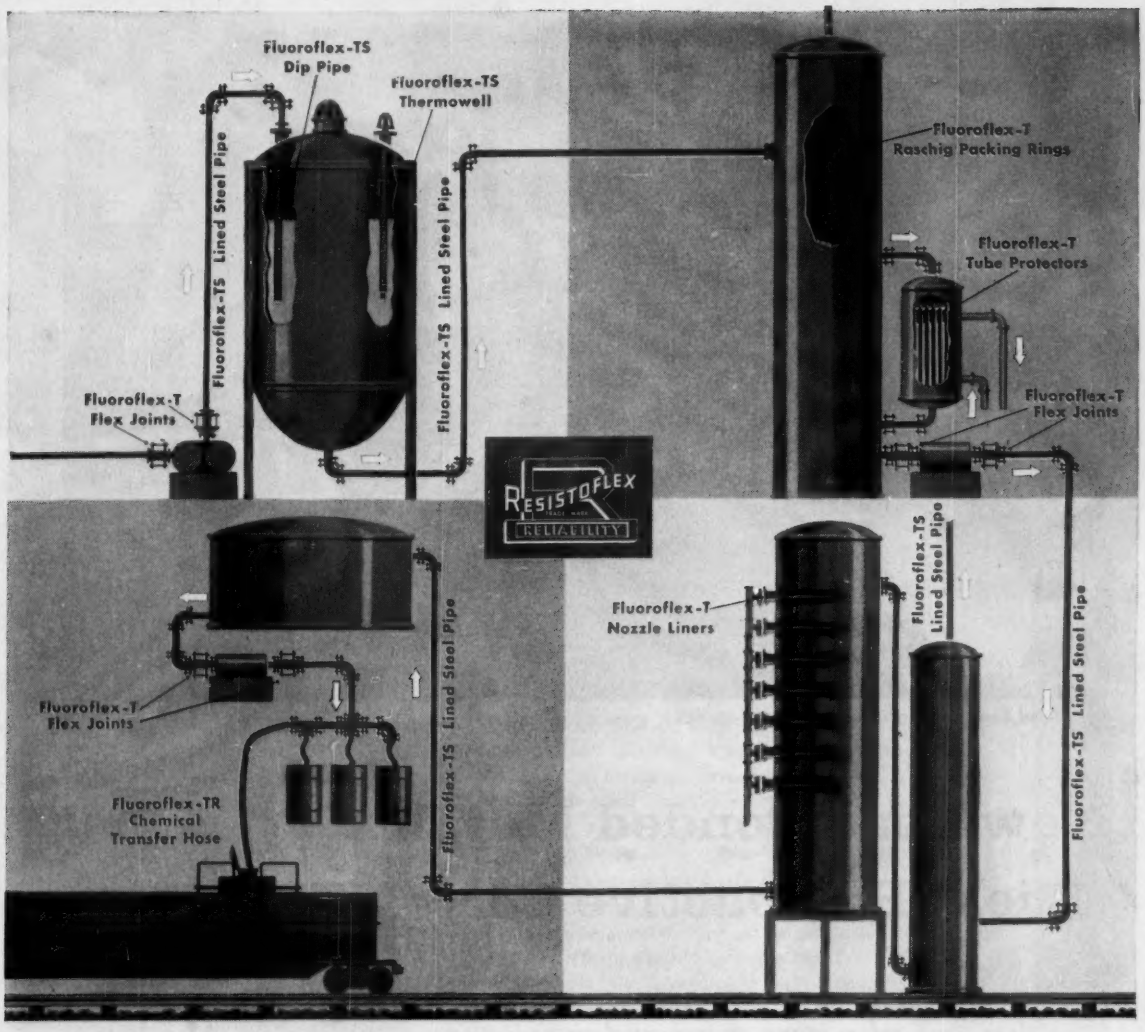
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About the Author



EDWARD ALLEN *is safety director for Marsh & McLellan-Cosgrove & Co., a large insurance brokerage company. He sees to it that insurance company safety engineers do a good job and also works on improving supervisory training methods in accident prevention. Mr. Allen is a mining engineer by training and early experience, having worked in that capacity for several coal companies in Pennsylvania. Later, he worked for Aetna Insurance Co. and Todd Shipbuilding in New York as safety engineer, then joined his present employer for whom he has worked 14 years. He is now located in Los Angeles.*

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## HERE'S WHY corrosion-proof fluid-handling components of FLUOROFLEX-T (TEFLON) assure production savings, non-contamination:

**Fluoroflex®-T Piping Products** as shown above can be used with complete and proven assurance that they will not corrode or build up solids which can contaminate sensitive products. Specially processed of Teflon® resins by patented Resistoflex methods, they can handle the most difficult materials up to 500°F. They are completely resistant to any chemical except high-temperature fluorine and the molten alkali metals.

**Fluoroflex-T Piping costs no more on an installed-cost basis** than other corrosion-proof systems in common use today. Initial material costs have been lowered by recent price reductions made possible by advanced technology and increasing volume. Installation costs are inherently low as a result of skillful design which features easily-bolted-together units with prefabricated, flanged sections.

**Fluoroflex-T Piping costs LESS on a performance basis.** Savings in operation are assured—with decreased maintenance, long service life, and the elimination of process headaches and downtime.

So, if *you* have problems of corrosion—want to reduce maintenance or replacement costs and eliminate process downtime or product loss—consult Resistoflex. Write for more information today.

**RESISTOFLEX**
**CORPORATION**

*Complete systems for corrosive service*

***Plants*** **in Roseland, N. J. • Anaheim, Calif. • Dallas, Tex.**
***Sales Offices*** **in major cities**

**Fluoroflex is a Resistoflex trademark, reg. U. S. Pat. Off.*
**Teflon is DuPont's trademark for TFE fluorocarbon resins.*



Lead bonded stainless steel, 3- to 5-in. thick, goes into demineralizers handling radioactive water.

# New Lead-Bonded Metals Shield Radioactive Corrosives

***Unique combinations of lead bonded to aluminum or stainless steel solve many severe nuclear-radiation shielding problems where corrosives are involved.***

Lead plays a well-known, although limited, role in nuclear devices. It's an excellent shield against gamma radiation* but has poor mechanical properties.

A recent development of Knapp Mills (Long Island City, N. Y.) should give a big boost to lead in nuclear applications, particularly in the handling of radioactive corrosives. The development: lead bonded to aluminum or stainless steel.

Homogeneous lead-lined steel or copper, where lead is metallurgically bonded to the base metal, has been available for many years. The trick is to form such a bond between lead and metals having natural oxide coatings. Apparently Knapp Mills has solved the problem of getting through or removing the oxide film on aluminum and stainless.

For stationary nuclear reactors, lead has never become a big factor as a shielding material. Concrete and water can do the job just as effectively and at a lower cost.

▶ **Light Lead**—But for mobile systems, weight and volume are extremely important considerations. In practice, lead as a gamma shield is "lighter" than water or concrete. Because it is such an excellent shield, a small amount of lead is required in many situations, calling for a lower surface area, volume and weight, compared to say concrete (*see table p.* 254).

This "mobile" market, a relatively small one now, includes nuclear-rocket or aircraft engines, transportable power reactors, shipping and processing atomic fuels.

The new combinations of lead-stainless and lead-aluminum should enter this picture where particularly corrosive materials are handled. Stainless for instance, provides corrosion resistance, lead acts as the radioactive shield.

Knapp Mills engineers have designed and built five spent-fuel shipping casks, for the Polaris missile program, under contract with Knolls Atomic Power Laboratory. Weighing 125 tons each, the casks have a stainless-clad carbon-steel shield with a thick wall of lead bonded to the steel.

Normal lead thickness, for gamma shielding, ranges from 1 to 8-in. For just corrosive service, thickness

* Paraffin wax, polyethylene or borated polyethylene added to lead, produces a material resistant to gamma and neutron radiation.







# *Sulphur Compounds Causing Corrosion?*

## ...Test **HAYNES** Alloys

The combination of sulphur dioxide or hydrogen sulphide *and moisture* spells trouble! Expensive trouble . . . in terms of corroded equipment. Yet even these tough combinations can be handled safely by HASTELLOY alloys C and D. Both alloys are highly resistant to these moist gases up to 160 deg. F.

Sulphur alone causes costly corrosion damage, too. In one plant, traces of sulphur dioxide and trioxide in a light hydrocarbon stream caused severe pitting. Seventeen alloys were tested on stream . . . 16 pitted. Only one . . . HASTELLOY alloy B . . . emerged unmarked.

There are 9 HAYNES corrosion-resistant alloys developed during a 30-year concentrated study on corrosion problems and metals best suited to solve them. You can capitalize on these years of experience.

**Send for test samples** . . . Write us a letter outlining your corrosion problem. We'll send a free test sample of an alloy best suited to resist it. Address your letter to Haynes Stellite Company, 270 Park Avenue, New York 17, N. Y. Descriptive literature available.







**HAYNES**
**ALLOYS**
**HAYNES STELLITE COMPANY**

*Division of*
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Kokomo, Indiana

UNION CARBIDE

"Haynes," "Hastelloy," and "Union Carbide" are registered trade marks of Union Carbide Corporation.

## Radioactive shielding: lead better than iron, concrete

| Material | Lead equivalent, mm. | Corresponding thickness of materials, mm. X-rays excited at peak voltages of 150 kv. | 200 kv. | 300 kv. | 400 kv. | Gamma rays |
|---|---|---|---|---|---|---|
| Iron: (7.9 g./cm.³) | 1 | 11 | 12 | 12 | 11 | 2.5 |
| | 2 | 25 | 27 | 20 | 18 | 5 |
| | 3 | 37 | 40 | 28 | 23 | 7 |
| | 4 | 50 | 55 | 35 | 28 | 8.5 |
| | 6 | | | 48 | 38 | 12 |
| | 8 | | | 60 | 45 | 16 |
| | 10 | | | 75 | 55 | 19 |
| | 15 | | | | 75 | 27 |
| | 20 | | | | | 35 |
| | 50 | | | | | 80 |
| | 100 | | | | | 150 |
| Concrete: (2 parts ballast, 2 parts sand, 1 part cement; 2.2 g./cm.³) | 1 | 85 | 80 | 60 | 50 | 8 |
| | 2 | 160 | 150 | 95 | 75 | 16 |
| | 3 | 230 | 210 | 125 | 100 | 22 |
| | 4 | 295 | 275 | 150 | 120 | 29 |
| | 6 | | | 210 | 150 | 40 |
| | 8 | | | 260 | 185 | 55 |
| | 10 | | | 300 | 220 | 65 |
| | 15 | | | | 300 | 90 |
| | 20 | | | | | 120 |
| | 50 | | | | | 280 |
| | 100 | | | | | 550 |

need not be more than ⅛ to ¾-in.

►**No Tin** — Where high-temperatures are involved, the lead-metal bond is achieved without a tin-containing flux. Technique produces a bond capable of withstanding temperatures up to the melting point of lead (621 F.) without separation.

Tin agents become plastic at 250 F. and any cycling, vibration or shock will break the bond at or above that temperature.

Also, tin will contaminate lead, making it less resistant to corrosives.

Knapp Mills is not revealing the techniques developed to bond lead to aluminum and stainless, except to say that they are variations of standard practices, and no chloride-containing flux is used on stainless steel. The bond is such that lead expands and contracts with the base metal: there is no creep or separation, and no air gap between the metals.

With a relatively thin lead coating, the new combinations are offered as new materials of construction for handling nonradioactive corrosives. Applications are definitely limited now. But, lead-aluminum heating and cooling coils (2-in. O.D., 100 psi.) are used in viscose rayon processing and in chromium plating tanks. And lead-bonded stainless tubesheets have been installed in a heat exchanger handling fertilizer solutions. Another chemical plant has installed a lead-stainless heating coil, where the outside is lead, the inside stainless. Coil is 10-ft. dia., 2½-in. O.D., handles 200 psi. of corrosive steam and weighs 10 tons.

►**Bucking Trend** — However, the trend in the chemical industry seems to be away from lead. Plastics are taking over, where temperature permits, in a number of acid plants, where lead once reigned supreme.

Lead is heavy, has poor mechanical properties, poor abrasion resistance, and when used as sheet lining, requires the services of skilled lead burners—a vanishing breed. The homogeneously bonded metals, according to Knapp Mills, do not call for lead burners during fabrication or repair. Bonded sheets, during construction, are joined by removing some of the lead back from the joint, welding the base metal, then filling in the lead over the weld. This operation does not require a lead burner.

It remains to be seen whether the new lead-bonded materials will have a large impact in chemical processing.

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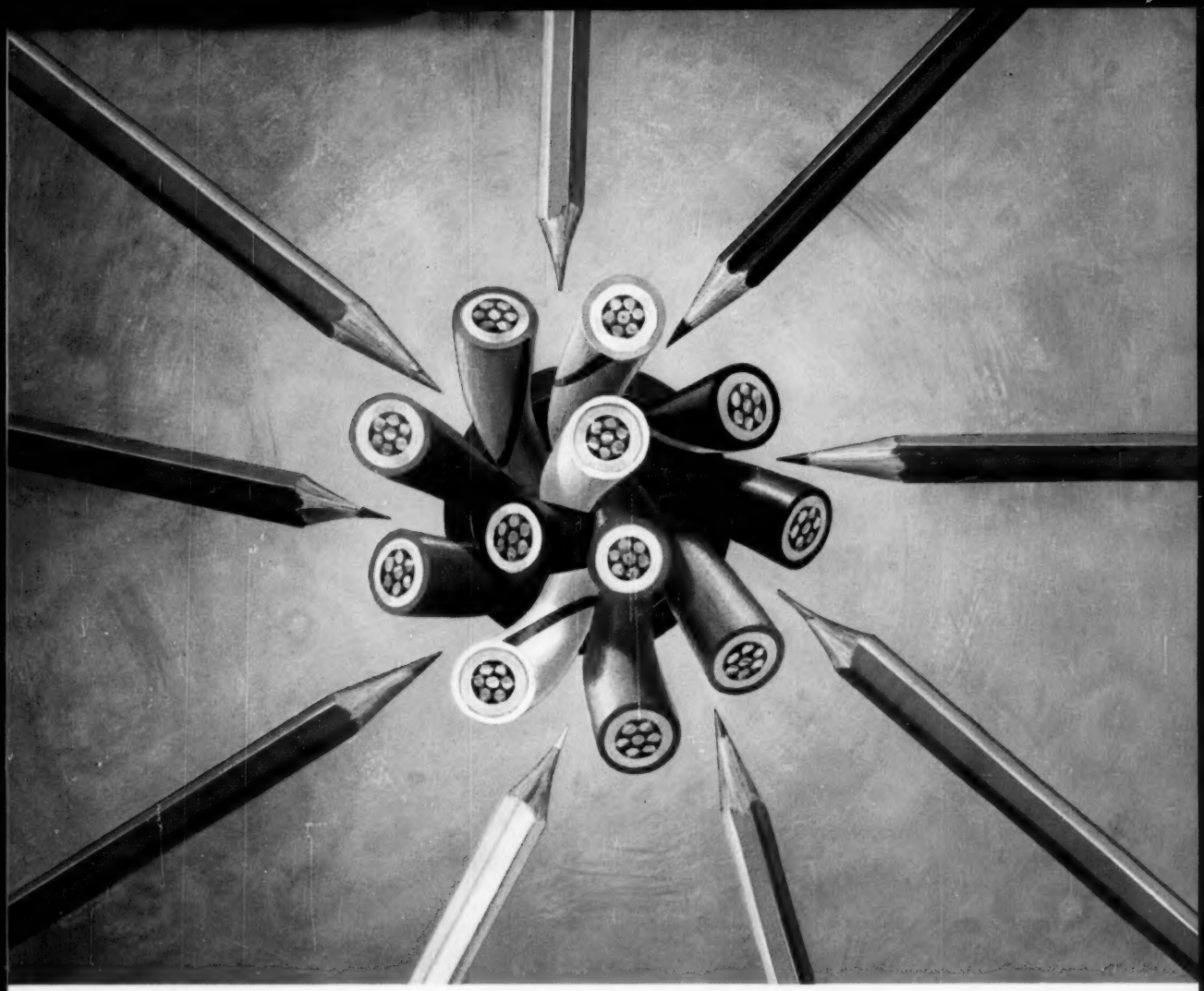
## Small Grain Size Improves Refractory Metals

A new technique for substantially reducing grain size in electron-beam melted and cast refractory metals and alloys improves their working characteristics. This comes from Stauffer-Temescal, Richmond, Calif., developer of the method.

A combination of electron-beam processing and critical composition control, technique is effective with all the refractory alloys so far tested. Patent applications covering electron-beam technology used in the process have been filed in the U. S. and in thirty-three foreign countries.

The most significant effect is a marked improvement in fabricability. While ductile refractory alloys such as 90-10 tantalum-tungsten had previously been produced by the grain-boundary refining action of electron-beam melting, the more refractory metals, particularly pure tungsten and molybdenum, still presented serious problems in fabrication due to the large crystal structure always present in the cast ingot. The presence of these large crystals made deformation failures along lines of crystallographic weakness a common occurrence. Thus, cast-tungsten ingot would frequently rupture under the stress of forging.

Reduction of grain size reduces the directionality of the material by introducing an element of randomness to the crystal structure. Fine-grain crystals are less likely to be



DRAW YOUR OWN CONCLUSIONS

# about the versatility of this new, standard control cable from Rome

Start by listing all the factors you consider important in a control cable.

Then compare your list with what Rome's new standard control cable (designated as the CT line) offers. We sum it up in one word: *versatility*—the ability of this new cable to meet most of your control cable needs.

For example, you can use CT cable with either AC or DC circuits. For voltages to 600 there's Type B; to 1000, Type C —both in accordance with new IPCEA-NEMA standards.

How about number of conductors? Specify from 2 to 37, in No. 10 or No. 12 AWG copper. Each conductor is insulated with polyethylene to give you maximum performance in a dielectric material, particularly where *moisture* is a problem. This insulation also stands up to acids, alkalies and oils. So CT is well suited to use in *hazardous* environments.

Over each insulated conductor you also have a Synthinol (polyvinylchloride) jacket. This same material is used to jacket the entire cable. Result: *added* resistance to heat, chemicals, and corrosion. And, good mechanical protection for the insulation, as well as a flame retardant barrier.

Full color coding (in keeping with IPCEA-NEMA, Method I) means you can make correct connections, quickly. And it will save you money in testing and maintenance.

Flexible, clean and light in weight, CT cables are also *smaller* in over-all size than similarly rated rubber-insulated cables. Use smaller conduit and fittings. Put more conductors in existing conduit, or use it in tray or trough.

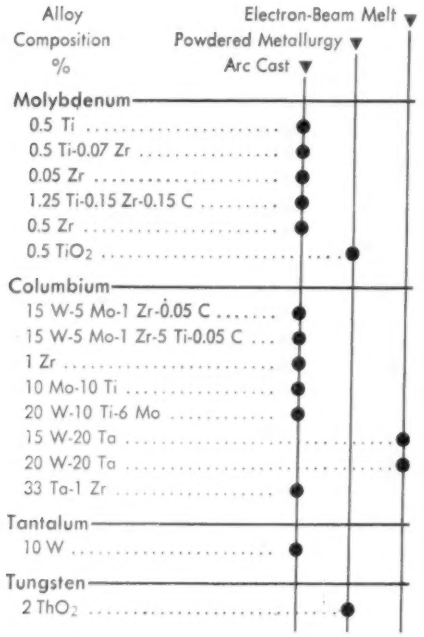
*All the facts and figures about the* versatile *new CT cable —including what sizes are available "off the shelf"—are summed up in a 4-page booklet. For your free copy, write to the Rome Cable Div. of Alcoa, Dept. IN-100, Rome, N.Y.*

**Special requirements?** As a cable specialist, Rome can answer any of your control cable problems not met by this standard construction. Ask your Alcoa-Rome salesman for details.

**ROME CABLE**
DIVISION OF **ALCOA**

aligned along common planes and stresses are more evenly absorbed.

Among other effects imparted to tungsten and molybdenum by the new casting technique are improved ultimate strength in the annealed condition and after 90% cold work, and a reduction in the effect of cold work. Molybdenum cast by the new process does not require extrusion before forging in a closed-die forge. Moreover, these properties are not markedly affected by recrystallization during reheating or welding.




***Refractory metals, in the form of sheets, is the goal of an accelerated development program by the U.S. Navy. Pure metals and alloys (left) are under investigation. Sheets will make fabrication of large equipment possible.***

# PACE QUICKENS ON REFRACTORY SHEET DEVELOPMENTS

Refractory metals have been under development for a number of years, but until recently, none of them could be considered for large, structural applications. Many are hard, brittle and difficult to work into sheets. Forged parts are available, and deep drawing and spinning methods are useful—but the only way to produce large pieces of equipment is with sheets of metal or alloy.

Some major advances are coming in this area as a number of metal producers concentrate their efforts on making this difficult mill product.

► **Mo Well Along** — For sheets, molybdenum is the most advanced material, although columbium is well along in this area. Competition between the two metals is very spirited for high-temperature applications. Columbium has the advantage of ductility and weldability. Molybdenum has superior high-temperature strength. Both metals are not good in oxidizing environments at high temperatures. Above 2,500 F., tungsten and tantalum are considered more suitable.

Refractory metal producers have produced sheets of unalloyed metals, except for tungsten, in sizes up to 36 x 96-in., 0.040-in. thick. Tungsten sheets are limited by equipment available, and are rolled in sizes up to 20 x 36 x 0.080 in.

Sheets are produced in conventional equipment at the present time. But many fabricators are installing new furnace equipment for preheating bar and sheet prior to rolling. Du Pont, Metal Products Div., is setting up a refractory-metal conversion plant in Baltimore. The new facility at Universal-Cyclops Co., Bridgeville, Pa., includes two 4,000 F. furnaces.

In addition, many companies are installing new mill equipment for sheet: Wah Chang in Albany, Ore., Sylvania in Towanda, Pa., Universal-Cyclops and Du Pont.

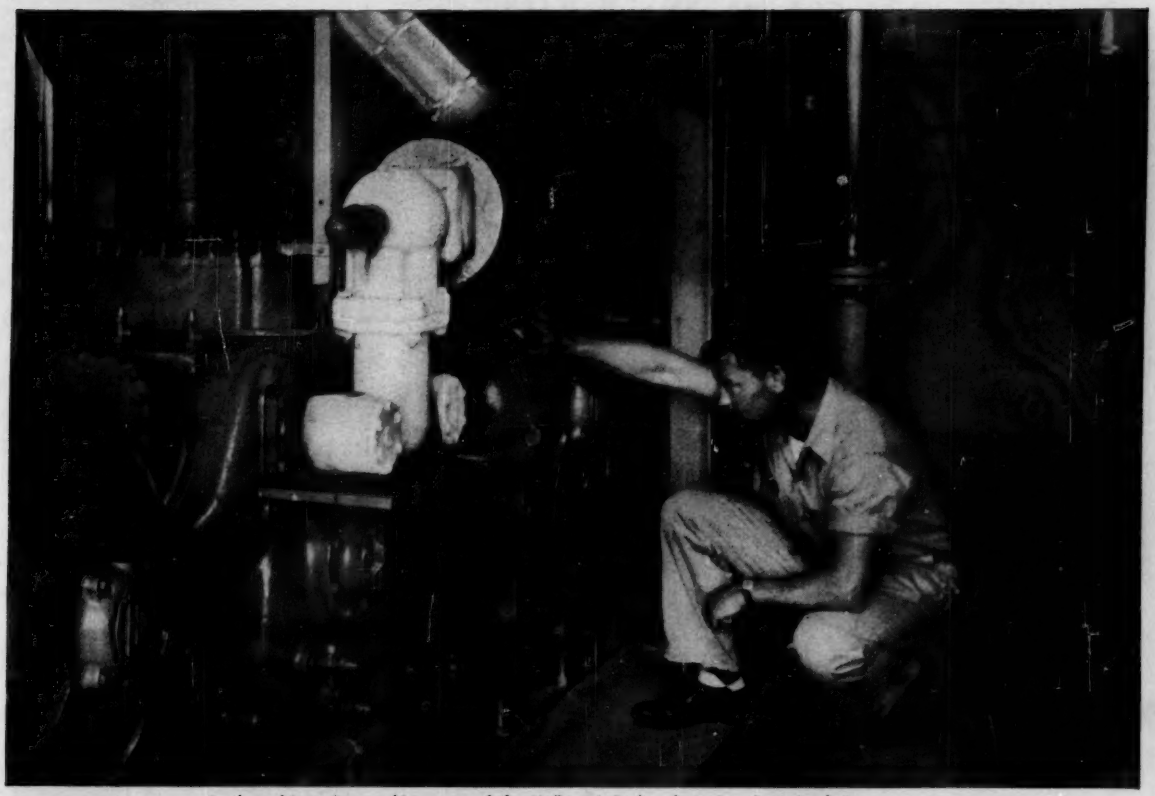
► **Need Better Sheet**—Most mill experience is on molybdenum and its alloys (see table). But a number of quality deficiencies have been observed, including surface contamination, brittleness, laminations.

Some progress has been made in eliminating these difficulties with unalloyed molybdenum and Mo-0.5% Ti alloy. However, experience with sheet rolling on the newer Mo alloys is negligible. Sheet development on some of the strong columbium, tantalum and tungsten alloys is also very slight.

Because of the slow progress so far, the U.S. Navy has started a major program for sheet rolling refractory metals. An advisory Refractory Metals Sheet Rolling Panel has been set up, composed of members representing producers, users, research organizations and Government agencies. A number of programs for molybdenum and tungsten alloys have been set up, where the alloys have been qualified for production-development support.

► **New Coatings** — However, solving the sheet problems will not open up big markets for molybdenum or columbium as high-temperature materials until coatings are developed to reduce oxidation. There is some progress here. Cementation coating (nickel-carbide) looks good for Mo. And for columbium alloys, aluminum-silicon dipped or sprayed coatings, and aluminum-oxide base coatings show encouraging results. Sprayed zinc coatings look very good on columbium for short-time exposures to 2,000 F.

DOW | INSULATION



In the refrigeration machine room of the Hoffman-LaRoche plant, Styrofoam insulation prevents condensation on protected pipes. Moisture cannot impair its permanently high insulating efficiency.

# STYROFOAM® PREVENTS CONDENSATION

## even where temperatures range 120 degrees in one pipe!

"Because Styrofoam is its own vapor barrier and is readily installed at low cost, we specify it exclusively where sub-normal temperatures are involved," asserts Charles Wright, project engineer for Hoffman-LaRoche Inc.

The Nutley, New Jersey, plant began using Styrofoam* eight years ago, both for additions to the cooling systems and for replacement of another material which frequently developed defects. Today, 50% of all brine and chilled water lines are insulated with Styrofoam.

"The greatest possible demands are made on the insulation," Mr. Wright continues. "We not only have two systems, zero and –30°F., but we also have dual-temperature applications where Styrofoam must effectively insulate pipes with brine passing through at 0°F. and at 120°F. at different times. Such extremes put the moisture and vapor resistance of the insulation system to a severe test."

Notice in the photo above the ice build-up on a section of the line left exposed for service purposes. Because of the moisture-resistant qualities of Styrofoam—because it stays dry inside—condensation which may creep along the pipe, even when a mastic sealer is used, does not impair its insulating efficiency. And since Styrofoam insulation is an effective moisture and vapor barrier, moisture does not penetrate *through* the insulation.

"Our installation costs have been reduced substantially by the use of Styrofoam, too," reports Mr. Wright. "It is readily placed in position and secured to the pipe. No special pipe supports are required, because the weight factor of Styrofoam is practically negligible—only 2.4 ounces per board foot."

Styrofoam is supplied by Dow to the fabricators listed below—pipe and vessel insulation experts who make both standard and special coverings. For complete information call the fabricator near you. Or write THE DOW CHEMICAL COMPANY, Midland, Mich., Plastics Merchandising Dept. 1649AK11-14.

*Dow's registered trademark for its expanded polystyrene.

**PIPE AND VESSEL COVERING FABRICATORS**

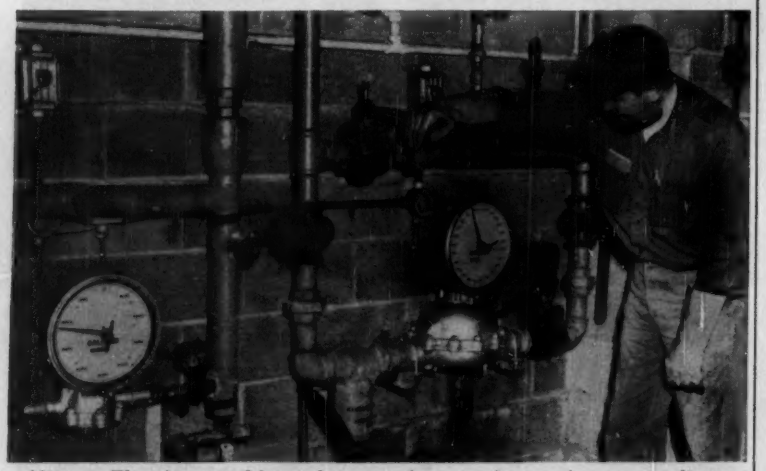
**DAL-VIR INC., Elkhart, Indiana • GLO-BRITE, Chicago, Illinois • KENNEDY INDUSTRIES, Los Angeles, California • KRANSCO MANUFACTURING COMPANY, South San Francisco, California • MMM, INCORPORATED, Houston, Texas • ROBINSON INDUSTRIES, Coleman, Michigan • STYRO FABRICATORS, Kansas City, Kansas • STYROFORMICS, INC., Somerville, Mass. • STYROPLASTICS, INCORPORATED, Minneapolis, Minnesota • TUFFLITE PLASTICS, INC., Ballston Spa, New York**

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# Complete Batch Uniformity

## When Liquids are measured with Niagara Electricontact Meters



*Niagara Electricontact Meters being used to simultaneously meter sodium hydroxide (right) and water (left) in a large eastern chemical plant.*

## *The gallonage you set is what you get . . . EXACTLY!*

Whatever your process — if you measure, meter, control or add liquids, you can be sure of absolute batch or process uniformity with Niagara Electricontact Meters.

Exacting accuracy is assured by positive displacement Niagara metering. When the required volume has passed through the meter, the flow is automatically stopped by a solenoid valve activated by the meter itself. There is no possibility of human error. Dirty sight glasses offer no problem.

Time and labor are saved. The central control station shown above permits the operator to accurately measure the dilution of caustic soda to precise process requirements without leaving his station. Since he never has contact with the caustic, the entire process is carried out in a safer fashion. Obsolete methods of dipping, rodding are a thing of the past with Niagara Meters.

Why not let us show you how Niagara Meters can improve your process? Mail the coupon today for a free catalog.

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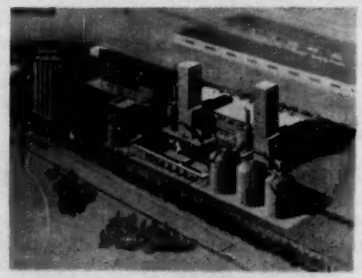

CPI NEWS BRIEFS . . .

*(continued from page 122)*

will make new synthetic rubbers. Design and engineering for the project are being handled by Crawford & Russell, Inc., Stamford, Conn. Due to be completed next fall, the unit will initially make synthetic balata and ethylene-propylene types of rubber.

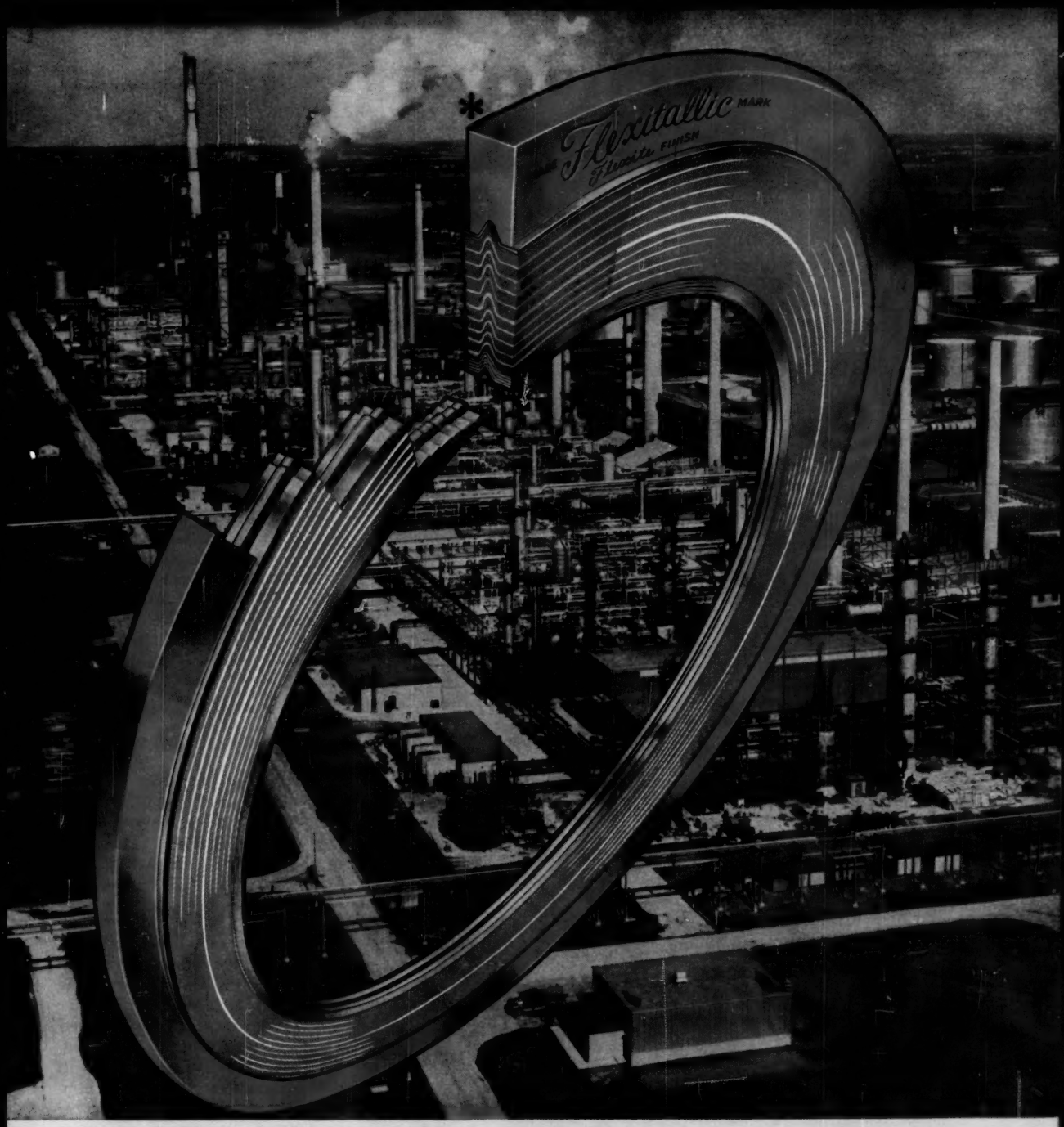
**United Carbon Co.** plans to build a carbon-black plant in Southern California to serve the Pacific Coast area. Currently, carbon black for consumption on the coast must be shipped from the South or Southwest. Company hasn't selected a site for the facility yet, but discloses that initial capacity will be 64 million lb./yr.

**Dynatech Plastics, Inc.,** has completed the first step in an expansion program by moving into a new plant at Santa Ana, Calif. Company manufactures injection moldings, by means of advanced screw-plastification techniques developed in Germany.



**Air Products, Inc.,** Allentown, Pa., is building at Cleveland the $10-million oxygen plant shown in the drawing above. Scheduled for completion early next year, it will supply 500 tons/day of pure oxygen to the Cleveland Works of Jones & Laughlin Steel Corp. plus 70 tons/day to other industries in the area. Air Products is currently erecting four other plants to serve steel manufacturers; one is a 340-ton/day oxygen unit to feed open-hearth roof jets at the J & L Works in Pittsburgh.

**Container Corp. of America,** Chicago, has opened a new marketing and research center at Oaks, Pa.,




## End corrosion in gasket inventory

The gold Flexite Finish* for the metal gauge rings in Flexitallic Compression-Gauge Gaskets is new. It is highly corrosion resistant when exposed to severest weathering in open construction projects or in stock. The Flexite Finish provides for ease of identification and a clean, long-lived installation. Write for samples.

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WITH Flexite FINISH

*The gold Flexite Finish is a development of the Flexitallic Gasket Co. (Originators of Spiral Wound Construction) — Register applied for on both name and color. Flexitallic Blue is our exclusive blue-dyed Canadian asbestos filler. Look for the blue and gold color combination as the mark of Flexitallic quality.



These RMC thermometers have just been submerged in water for the first of a severe series of tests to make sure of perfect hermetic sealing.

# Moisture will never bother your RMC dial thermometer

The RMC hermetic sealing process makes absolutely certain that humid air will not be sealed in the instrument and locks all moisture out permanently. Each thermometer then goes through a series of severe tests. Only those with perfect sealing are accepted for delivery. When you order from RMC you get the *only* industrial thermometer that can *never* be affected by internal dial fogging or bimetal freeze-up.

## "Bimetal Freeze-up" More Serious Than Dial Fogging

The first sign of moisture in a dial thermometer usually shows up as condensation inside the dial glass. You are probably familiar with this dial fogging problem which causes difficult reading and the eventual corrosion of the bimetallic element. You may not, however, be familiar with another and actually more serious moisture problem—bimetal "freeze-up."

If moisture is sealed in, or enters a thermometer dial it will find its way to the bimetal element. Then at extreme low temperatures this moisture freezes on the element and bearing surfaces, and the bimetal element will not function should the temperature go lower. Therefore, the operator of the equipment would never know that the temperature had gone below the last indication when the element became frozen.

Here's what makes such a condition hard to spot. The thermometer would operate properly again after a temperature rise of perhaps 20°, and would continue accurate indication even though the fluid dropped again to an even lower temperature than before. However, after it remained at the new low for a few hours, it would again freeze up. Then, as before, any further drop in temperature would not be indicated.

Only a dry-air hermetic seal, as used by RMC, can prevent both dial fogging and bimetal freeze-up. RMC even goes a step further by providing for recalibration at any time without breaking the air-tight seal. An external dial reset screw—exclusive with RMC—permits recalibration without opening the instrument in any way.

Write, wire or phone for general catalog. If yours is a special application, tell us your requirements—RMC engineers will work with you in solving it. Rochester Manufacturing Co., 209 Rockwood St., Rochester 10, N. Y. (Telephone: BRowning 1-2020).

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113 ROCKWOOD STREET • ROCHESTER 10, N.Y.

LIQUID LEVEL, TEMPERATURE and PRESSURE INSTRUMENTS

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22 mi. north of Philadelphia. It consists of a $1.5-million building that occupies 48,000 sq. ft. The center will be used to develop new packaging concepts, evaluate paperboard, plastics and other packaging materials, and carry out process research on printing and fabrication techniques. Also, it will provide technical service for the firm's carton plants and paperboard mills. Staff will include 135 people in sales and administration, as well as about 60 research and marketing specialists.

**Kaiser Aluminum & Chemical Corp.'s** Kaiser Refractories & Chemicals Div. is building a Technical Center at Mexico, Mo., to house research and other technical personnel. When completed, the center will be equipped to evaluate materials for the development of fireclay, silica and high-aluminum refractories; it will also serve as headquarters for the division's raw-materials department. The facility will consist of a one-story building containing 17,300 sq. ft.

**National Beryllia Corp.,** North Bergen, N. J., has completed a laboratory for conducting wet chemical trace analyses. Featured is equipment that can detect impurities in beryllium oxide when they are present in only a few parts per million.

**Johns Hopkins University's** Applied Physics Laboratory has awarded a $918,000 contract for construction of facilities for hypersonic-propulsion research. They will occupy a five-acre site, will permit advanced research on ramjet and other air-breathing engines at 4,000 F., stagnation pressures of 1,000 psi. and speeds of Mach 7. Construction will be by the William T. Lyons Co., Inc., Baltimore.

**Corning Glass Works** has announced plans for a 400-acre research and engineering center, which will be built near the firm's headquarters at Corning, N. Y. First step will be a two-story pilot plant containing 93,500 sq. ft. of floor space. It is scheduled for occupancy next May, will triple

Corning's experimental melting and processing facilities.

## *Offices*

**General Electric Co.'s** Atomic Power Equipment Department (APED) has completed a new, $750,000 headquarters building at San Jose, Calif. GE's commercial nuclear activities have been centralized at San Jose since 1956, and APED has over $22 million invested there and at its Vallecitos Atomic Laboratory in nearby Pleasanton.

**AviSun Corp.,** joint subsidiary of American Viscose Corp. and Sun Oil Co., will move its executive offices from Marcus Hook, Pa., to Philadelphia. The transfer will involve about 70 people now located at Marcus Hook or at the firm's plant in New Castle, Del.

**Gulf Oil Corp.** is moving the central office of its domestic traffic department from Pittsburgh to Houston. The firm's production, manufacturing and marketing departments are already headquartered in Houston.

**Du Pont's** Photo Products Department is transferring its New York district sales office and warehousing facilities from Manhattan, to Secaucus, N. J.

**Baird Atomic, Inc.,** Cambridge, Mass., has opened an office in Cleveland, Ohio, for sales and servicing of the firm's atomic instruments.

**The Alpha-Molykote Corp.,** Stamford, Conn., has established a branch office and technical-service center in Chicago. The firm makes molybdenum disulfide specialty lubricants.

**Shell Chemical Co.'s** synthetic rubber division has opened two new regional sales offices as part of its current expansion program. A western district office is now located at Lakewood, Calif., and a





The photograph below shows RMC Pressure Gauges undergoing severe vibration testing on big Calidyne High Frequency Vibration Test System. These gauges undergo accelerated tests from 0-2000 CPS—up to 25 G intensity and up to 350° F.

# RMC *direct-drive* Pressure Gauge eliminates vibration problems

The RMC *direct-drive* Pressure Gauge is rugged and resilient. It is the first direct-drive helical bourdon gauge—inlet pressure acts directly on a helical bourdon to drive the pointer. The helical coil, as a simple spring, is resilient and fully balanced, and is not affected by shock or vibration.

With its direct drive, there are no gears or linkage to gyrate and score on vibration—no unbalanced bourdon "C" springs and hair springs to whip. Direct-drive action means a stable pointer—no loss of power, too. Pointer action of the RMC gauge is steady, positive and alive—no need to tap the gauge to read. Soft hair springs and backlash springs are not used.

Shown at far right is the pointer-coil unit used in 3″ and 5″ concentric models. The pointer in these models is attached directly to the end of the pressure element. At the near right is a cutaway view of the compact 1½″ and 2″ eccentric models. The pointer in these models is actuated directly by a simple pivot. Both types offer the same direct-drive, helical bourdon advantages. Pressure ranges from 0-1000 to 0-10,000 psi.



Write, wire or phone for general catalog. If yours is a special application, tell us your requirements—RMC engineers will work with you in solving it. Rochester Manufacturing Co., 113 Rockwood St., Rochester 10, N. Y. (Telephone: BRowning 1-2020).

RMC

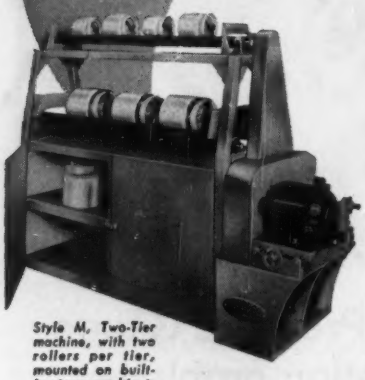
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JAR ROLLING MACHINES



*Style M, Two-Tier machine, with two rollers per tier, mounted on built-in storage cabinet.*

Multiple batches of similar or different materials can be economically ground, pulverized or mixed simultaneously on a versatile Abbé Jar Rolling Machine.

Jars, bottles or containers of different sizes can be used at one time. Each jar can be removed after its full grinding or mixing cycle has been completed—without stopping the machine.

Modern, rugged Abbé Jar Rolling Machines are available to handle single or parallel rows of jars, and in double or triple tiers for processing as many jars as required. Standard porcelain or steel jars range in size from 1 quart to 6 gallons. Built-in storage cabinets on tiered machines are optional.

Write for NEW Abbé Jar Rolling Machine Catalog 79



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Designers and Manufacturers of
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CPI NEWS BRIEFS . . .

new central district office is in Cleveland.

**The Goodyear Tire & Rubber Co.** has begun construction of a $1.25-million district office and warehouse building in Elk Grove, Ill., near Chicago. The one-story facility, to contain 150,000 sq. ft. of office and warehouse space, will allow the company to expand and consolidate several operations now carried out in separate Chicago locations. Completion is scheduled for May, 1961.

**Will Corporation,** distributor of scientific laboratory apparatus and chemicals, has opened a Boston-area branch office, at Cambridge, Mass.

## *Companies*

**Standard Oil Co. of Calif.** has consolidated all its world-wide industrial and agricultural chemical activities into a new subsidiary known as California Chemical Co. Domestic subsidiaries merged into the new company include California Spray-Chemical Corp. and Oronite Chemical Co.

**Buchart Engineering Corp.,** York, Pa., has organized a new General Research & Development Div., with a staff qualified to cover the fields of engineering, physics, chemistry and metallurgy. The new division will provide research and development services for private industry and the government.

**Air Reduction Sales Co.,** New York, has formed a new Tonnage Product Sales Department to handle bulk or onsite sales of oxygen, hydrogen, nitrogen, argon and other industrial gases.

**Vitro Minerals Corp.,** subsidiary of Vitro Corp. of America and Rochester & Pittsburgh Coal Co., has executed a loan agreement with the U.S. Dept. of Interior, for exploratory work on the firm's new beryllium property in Juab

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THIS new Carlson Booklet, "Producing Stainless Steels . . . Exclusively," documents a unique, specialized service. Fully illustrated, it includes detailed sections on stainless steel plates, heads, forgings, special shapes, and other stainless products manufactured by Carlson.

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IN addition to the more usual grades, Carlson regularly produces stainless steel plate and plate products in this wide range of superior analyses in any thickness. Many of these grades are included in our mill inventory; the others can be rolled to your order.

These chromium-nickel analyses were developed to more closely match the exact requirements of process, nuclear, and space equipment. Each has one or more of the following advantages: increased corrosion and/or heat resistance, good machinability, ease of fabrication, and exceptionally high physical properties with low temperature heat treatment. By selecting the grade that gives you the combination of advantages you want, your costs can be reduced and the trouble-free life of your equipment extended.

Write today for details on these superior grades and for inventory information on all types of stainless steel plates and heads.

*Trade marks of Armco Steel Corporation

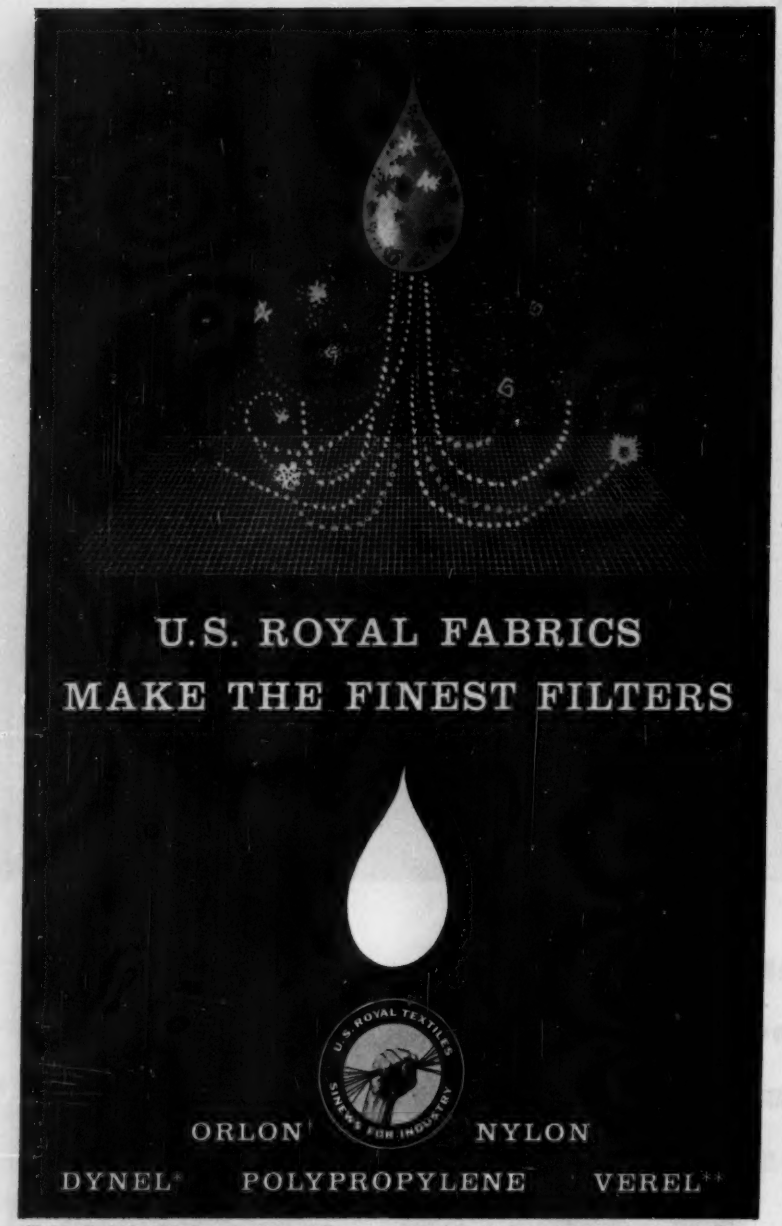
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Filter fabrics by U.S. Rubber are engineered to exacting service specifications. They offer maximum chemical and heat resistance, high abrasion resistance, and efficient cake retention-and-discharge properties. Write, wire or phone your specific requirements to Industrial Textiles Department at any of the following sales offices:

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CPI NEWS BRIEFS . . .

County, Utah. Vitro reports that the ore appears to be a new type, readily soluble in sulfuric acid and apparently amenable to ordinary hydrometallurgical processing.

**Transcontinental Gas Pipe Line Corp.** has formed a new, wholly owned subsidiary, Trans-Southern Pipeline Corp., to carry LPG from the Gulf Coast into the Southeast. The new firm will build a $63-million pipeline, will go into operation by next November with an initial capacity of 60,000 bbl./day. The pipeline will extend from near Houston to Danville, Va., with a 215-mile spur from Atlanta to the Georgia-Florida state line. At present, there is no pipeline providing LPG service to the Southeast.

**Godfrey L. Cabot, Inc.,** Boston, has consolidated itself and three of its subsidiaries—Cabot Carbon Co., Cabot Shops, Inc., and Cabot Gasoline Corp.—into a new entity named Cabot Corp. The company is said to be the world's largest manufacturer of carbon black; it also produces natural gas, LPG, natural gasoline, crude oil, pine tars, charcoal and other products.

**Hazelton-Nuclear Science Corp.,** recently formed in Palo Alto, Calif., is a West Coast affiliate of Hazleton Laboratories, Inc., Falls Church, Va., and Nuclear Science & Engineering Corp., Pittsburgh, Pa. The new firm offers consulting and other services in various areas of chemistry, biology and allied sciences.

**Girdler Corp.** is the new name of the former Girdler Construction Corp. Located in Louisville, Ky., the firm offers process design, engineering and construction of chemical plants for petrochemical, edible-oil and other industries.

## *International*

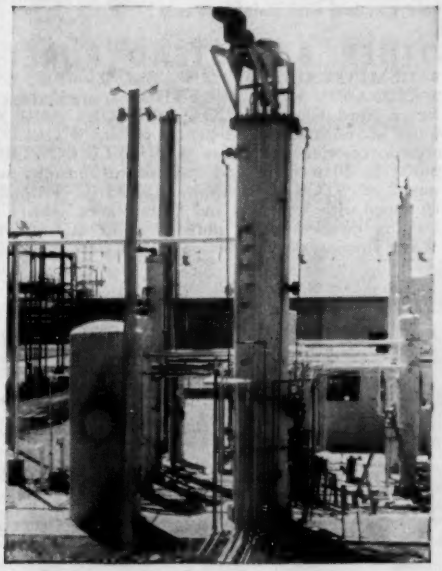
**Lebanon** will soon have its first plant for manufacture of household synthetic detergents. The

# 13 COOPERATING COMPANIES* SELECT GENERAL AMERICAN RDC COLUMN FOR PROTOTYPE PLANT

Lignite low temperature tar is a relatively new and unknown raw material. To determine its potential value, a cooperative research program was started by 13 companies in 1954 at the Battelle Memorial Institute.

One of the important developments has been a solvent extraction process . . . a countercurrent extraction of this tar with 75% methanol—25% water and commercial hexane . . . using the RDC column. The development appeared so promising that a prototype plant was constructed at Alcoa's Rockdale Works by Texas Power & Light Company incorporating a General American RDC pilot column. *Only* the RDC column combines all these advantages: High volumetric efficiency, high throughput capacity, elimination of interstage settling, flexibility for changing feed conditions, lower power requirements, simple construction, tolerance for solids.

For any applications dealing with liquid-liquid, liquid-solid, liquid-slurry extraction . . . why not get full information on a General American RDC column? (Write for Bulletin #T-1159) Remember, *it pays to plan with General American.*



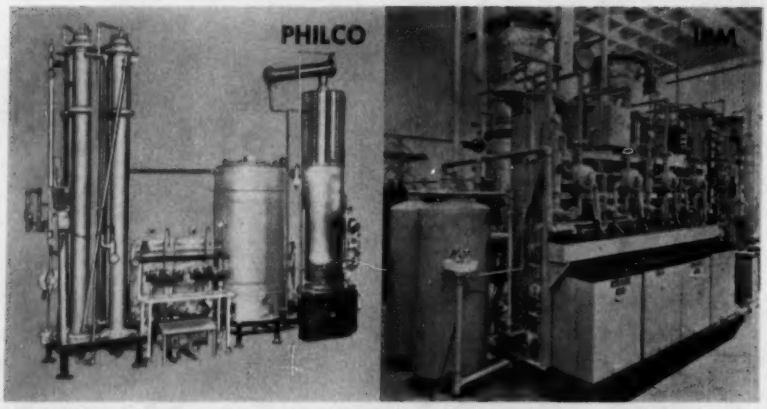
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**83 YEARS OF PURE WATER EXPERIENCE AT YOUR DISPOSAL** Today's, often complex, manufacturing procedures and techniques impose new demands of water purity and the production of same in high quantities hourly. Because Barnstead engineers know and understand all phases of water purification, most of America's leading manufacturers look to Barnstead to engineer Pure Water equipment to their particular specifications and requirements. Why not discuss your problem with Barnstead now!

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• DEMINERALIZERS, Mixed-Bed, Two-Bed, Four-Bed models with capacities up to 2500 GPH. • WATER STILLS from ½ to 1000 GPH including The Still You Never Need Clean. • COAGULATORS AND SAND FILTERS to pretreat feedwater where excessive sediment is present. • CARBON FILTERS to eliminate organics, organic coloring and odors. • PURITY CONTROL EQUIPMENT to check water purity in 30 seconds, and Puromatic Controller which diverts sub-standard water to waste. • STORAGE AND DISTRIBUTION SYSTEMS include Storage Tanks equipped with Ventgard and Ultra Violet light. Tin-lined Piping, Fittings, and Valves keeping distilled water pure to point of use. WRITE for new Catalog #160 on Water Demineralizers, Catalog "G" on Barnstead Stills and Accessories.

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CPI NEWS BRIEF . . .

facility will cost about $700,000, will have a capacity over 2,000 tons/yr. Announcement of the plant follows an agreement between Procter & Gamble AG, Lucerne, Switzerland (subsidiary of The Procter & Gamble Co., Cincinnati) and Trans-Mediterranean Co. of Beirut, which currently distributes P&G products in Lebanon. Investment for the plant will be furnished by Lebanese interests, and P&G will supply technical assistance and supervision for planning, constructing and operating the facility. Production is scheduled to start in 11-15 months, initially for local consumption but later perhaps for export as well.

**Yugoslavia** is to receive a $23-million loan from the U.S., to help establish a plastics and chemicals plant near Zagreb.

**West Germany:** The Procter & Gamble Co., Cincinnati, has founded a German subsidiary in Frankfurt called Procter & Gamble GmbH. with basic capital of $400,000. Initially, the subsidiary will only sell products made by the parent company or its sister companies elsewhere in Europe, but eventually it will open a plant—probably near Frankfurt—for production of detergents, chemicals, cosmetics and foodstuffs.

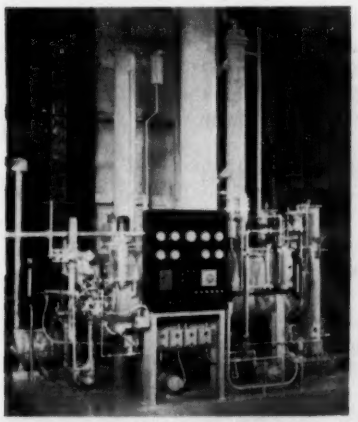
**Switzerland:** Tennessee Eastman Co., Kingsport, Tenn., has organized a new company, Eastman Research A.G., located at Zurich. Reasons for founding the firm: to expand research in a center that is convenient to scientific and industrial areas of Europe; to broaden Tennessee Eastman's research viewpoint by engaging European scientists.

**Canada:** Atomic Energy of Canada Ltd. has activated its new low-power reactor, "ZED-2," at the nuclear research laboratories at Chalk River, Ont. Built at a cost of $3 million, it will be used to test uranium fuels.

**El Salvador:** Refineria Shell de El Salvador S.A., subsidiary of Shell

Oil Co., has awarded a contract for engineering, purchasing and construction of its forthcoming 10,000-bbl./day refinery at Acajutla. Recipient of the contract is Fluor-Schuytvlot N.V., Haarlem, Holland, a subsidiary of The Fluor Corp., Ltd., Los Angeles. The refinery will include a crude unit, hydrodesulfurizer, platformer, tankage and offsite facilities.

**Mexico:** Officials of The Chemstrand Corp.'s division, Chemstrand Overseas, S.A., have announced that a new company will be formed to make nylon filament yarns at a plant near Mexico City. The facility is due to be completed and on stream next year.



**Canada:** Atomic Energy of Canada, Ltd., recently installed at its Chalk River, Ont., facilities the carbon-dioxide generator shown above. Produced by Louis De-Markus Corp., Buffalo, the generator will supply $CO_2$ purge gas for an experimental, 200,000-kw. NRU reactor.

**Japan:** Showa Denko and Du Pont are forming a joint venture firm, Showa Neoprene, with authorized capitalization of $9.7 million. New company will produce 8,000 tons/yr. neoprene at a plant in Kawasaki.

**West Germany** and **England** both have new chemical plants upcoming, as the result of a $20-million joint venture between California Chemical Co. (new subsidiary of


# When You Do It Yourself




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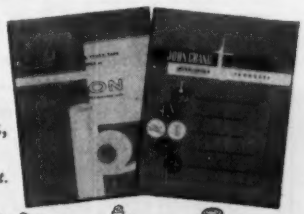
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Under the name, Chemlon, "John Crane" gives you full satisfaction on each of these points, plus engineering assistance on any problem you might have.



**Contact "John Crane" about your specific needs. Also ask for Bulletins T-110 and T-122.**

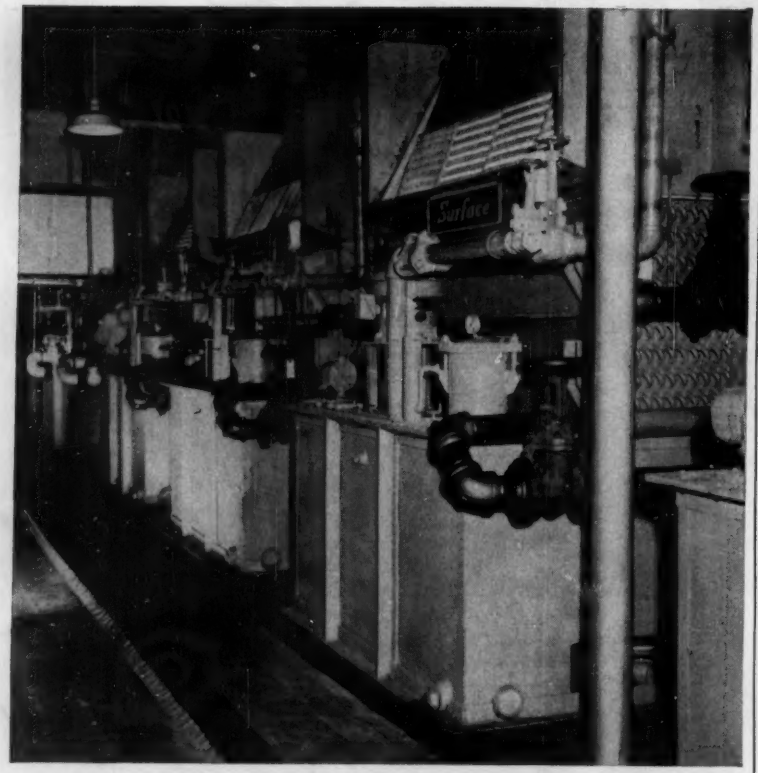
Crane Packing Co., 6451 Oakton Street, Morton Grove, Illinois, *(Chicago Suburb)*
*In Canada: Crane Packing Co., Ltd., Hamilton, Ont.*

**DuPont Trademark*

John Crane




**CRANE PACKING COMPANY**
OFFICES IN ALL PRINCIPAL CITIES




# 120 GRAINS CUT TO 45 IN 200,000 cfm OF AIR WITH 85° TOWER WATER

Without Kathabar, this job would have taken 1800 tons of refrigeration, at about 35F and reheating air from about 45F to 98F! With Kathabar the job took 63 hp instead of 2000. Ask the men who have seen Kathabar Type C units serve for years with practically no maintenance. Write for specific information.

Surface

**SURFACE COMBUSTION**

*Division of Midland-Ross Corporation* MR

*2380 Dorr St., Toledo 1, Ohio*

*Send facts on Kathabar systems for the following application:*

*name and title*.....

*company*.....

*street*.....

*city*.....*zone*.....*state*.....



Standard Oil Co. of Calif.; see p. 262) and the British Petroleum Co. Venture will include construction of aromatics plants adjacent to two existing BP refineries: one on the Isle of Grain, Kent, England, and the other at Dinslaken, West Germany. Initially, the two new units will produce 42 million lb./yr. orthoxylene, 50 million lb./yr. paraxylene and 36 million lb./yr. ethylbenzene.

**Iran:** Iranian Oil Refining Co. has awarded a contract worth about $5 million to Fluor-Schuytvlot N.V., Dutch subsidiary of The Fluor Corp., Los Angeles, for a U.O.P. Unifiner-Platformer for Iranian Oil's refinery at Abadan. Contract covers design, detailed engineering, purchasing and construction, and will be carried out by Fluor Engineering & Construction Co., Ltd., London. Completion of the project is scheduled for early 1962.

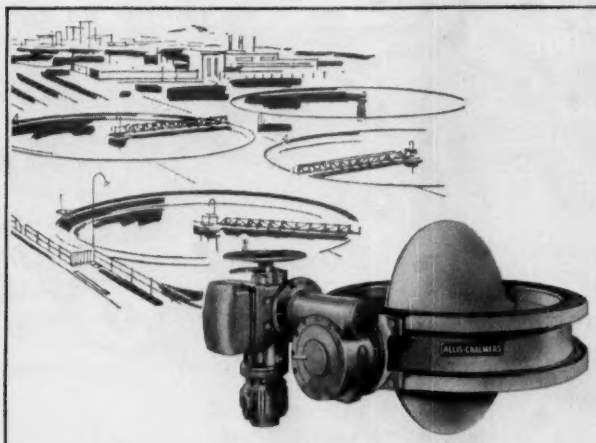
**Poland:** A 1,350-ton/day nitrogen fertilizer plant will be built in the Pulav district of Lublin Province. Unit is expected to be ready for operation late in 1965; its raw material will be natural gas piped from Western Ukrainia. Also being planned are facilities to make plastics, synthetic fibers and petrochemicals using natural gas from the same source.

**West Germany:** Houdry Process Corp., Philadelphia, and Chemische Werke Huels, Marl, West Germany, are forming an equally owned company to develop catalysts and to manufacture and sell each parent firm's line of catalysts. The new company, Katalysatorenwerke Houdry-Huels GmbH., will be located at Marl, will sell its products in the Western European market.

**Mexico:** Merck & Co., Inc., Rahway, N. J., will spend $1 million of a $1.35-million Latin-America expansion program in replacing its current pharmaceuticals facilities in Mexico City. Company will erect a new building that will permit a 40% increase in production.

The $350,000 balance will be

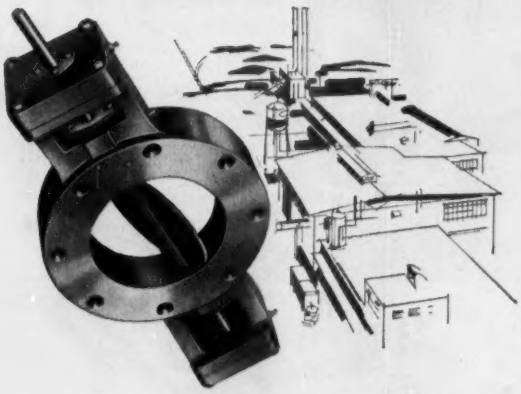
# ALLIS-CHALMERS



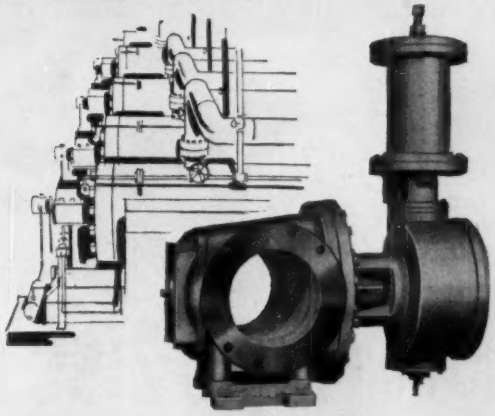
**BUTTERFLY VALVES** — For liquids or gases — uniform control in all positions, fast positive regulation and closure, minimum pressure drop. Compact and lightweight. Sizes from 1 in.



**BALL VALVES** — Easy manual shutoff under adverse conditions, and up to 150 psi. Slight wedging action gives unusually drop-tight closure. Sizes: 12 to 48 in.



**WAFER VALVES** — A new design of butterfly valves with space-saving flexibility, suited to most any type of operation. Sizes from 3 to 36 in., including high-pressure types.



***ROTOVALVE*** — A cone valve suited to virtually any type of operation or location. Offers the least pressure loss, greatest initial shutoff, controlled closing time, positive seating.

Now: for power plants, sewage and water works —

## a full line of rotary valves

**Serving you even better through a broader line**—Allis-Chalmers offers the finest in butterfly, ball and cone valves for industrial applications, power plants, sewage and water works. Also available are complete valving systems in standardized "packages" that provide *remote, telemetered control of valve operation.* These additions further round out Allis-Chalmers line that includes Angle, Needle, Relief valves, sleeve-type valves and accumulator systems. *For details, contact your Allis-Chalmers valve representative or write* **Allis-Chalmers,** *Milwaukee 1, Wisconsin.* Rotovalve is an Allis-Chalmers trademark.



A-1381




Keep your
crews busy
all year 'round

with **CARBO ZINC 11***

*the all-weather maintenance coating*

Most maintenance paints cannot be applied below 40° F. Not so with Carbo Zinc 11 . . . *the only protective coating that can be applied outdoors in cold weather.* Paint *anytime*, 12 months of the year, indoors or out . . . keeping a *smaller* crew busy full time. You still get protection far superior to standard maintenance paints.

- a zinc-filled inorganic protective coating
- water insoluble 20 minutes after applying
- fast drying, long-lasting galvanic protection for steel
- apply in humidity up to 95%, temperatures from –20° F. to 150° F.
- excellent resistance to water, coastal environment, brine, humidity, solvents

Use Carbo Zinc 11 without topcoat, or as primer with vinyl, Hypalon, epoxy, or inorganic topcoat. Resists undercutting and subfilm corrosion. Low material, application and maintenance costs.

Write for information, technical data, uses and samples. Also, see our catalog in CEC, pages 911-914.

6011 *Patent applied for

*Sales engineers in principal cities. Consult your telephone directory.*

**carboline COMPANY**

32-D Hanley Industrial Ct. St. Louis 17, Mo.

MAINTENANCE COATINGS WITH EXPERIENCE



used to build a pharmaceuticals plant in **Peru.** To be located in Lima, it will represent the first manufacture of Merck products in that country.

**India:** Sahu Jain, Ltd., Calcutta, will build a $20-million newsprint mill at Karad, 220 miles from Bombay. Plant will use bagasse (residue after extraction of sugar from cane or beets) as raw material, will have capacity of 60,000 tons/yr. newsprint. Technical assistance and patent rights will be granted by Crown Zellerbach Corp. and Hawaiian Development Co.

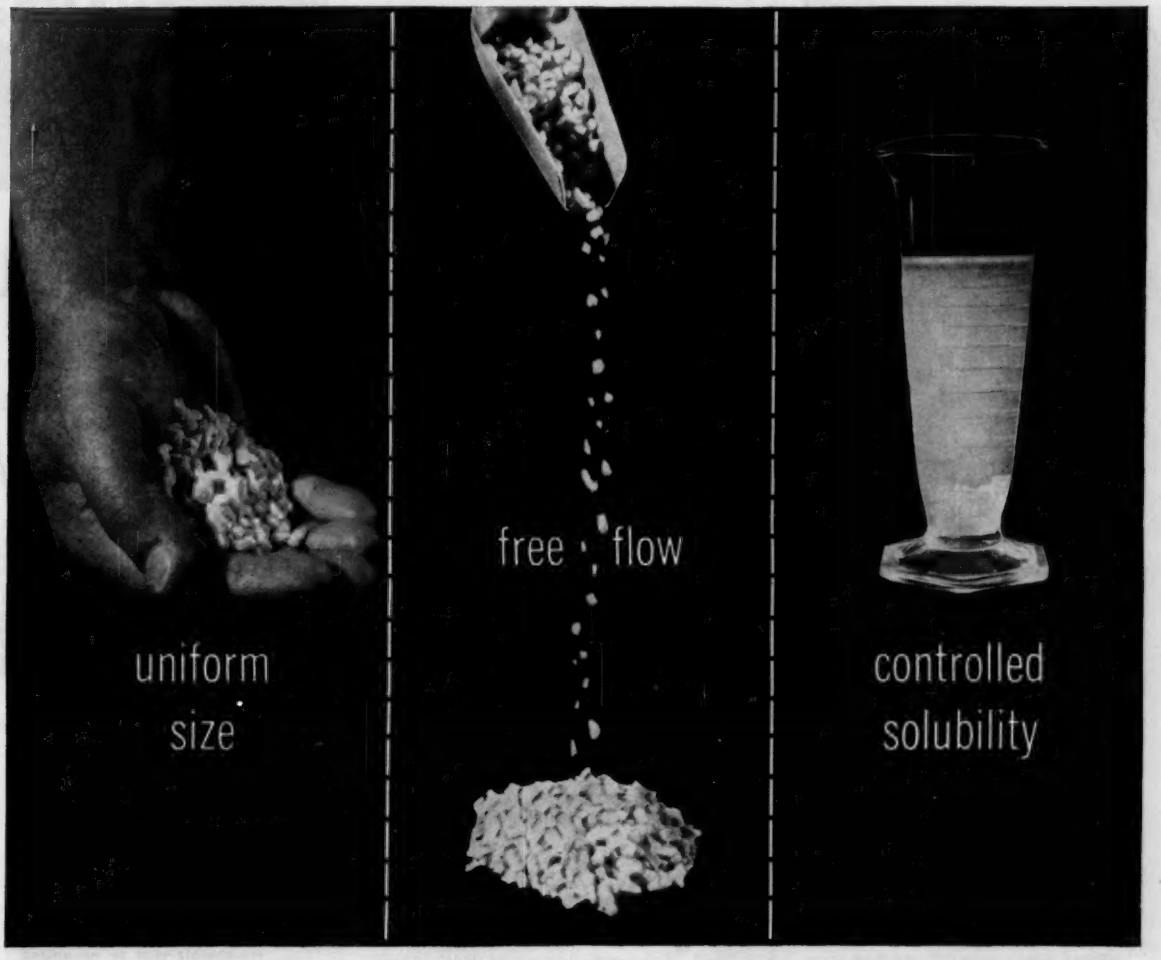
**Mexico:** Nalco Chemical Co., Chicago, will build a chemical plant at Saltillo. It will be operated by Nalco de Mexico, S.A. de C.V., will contain a total of 8,000 sq. ft. for office, plant and control laboratory facilities.

**Canada:** Refractories Engineering & Supplies, Ltd., Montreal, will build new facilities at Bronte, Ont., to make high-magnesia basic refractory mixes. Product will be used primarily by the steel industry. The company is affiliated with Kaiser Refractories & Chemicals Div., Kaiser Aluminum & Chemical Corp., and the basic mixes will be under license from Kaiser Refractories. Start of operation is scheduled for early next year.

**Holland:** Du Pont de Nemours (Nederland) N.V. will build a plant to process Delrin acetal resin at the firm's site in Dordrecht. The basic resin will be produced at Du Pont's plant in Parkersburg, W. Va., and the new Dutch installation will color, extrude, cut, package and ship the product for sales by Du Pont de Nemours International, S.A., Switzerland. Operations are scheduled to start in 1962.

**Brazil:** Union Carbide do Brazil, S.A., affiliate of Union Carbide Corp., will expand capacity of its polyethylene plant near Santos from 9 million to 24 million lb./yr. Project is due to be completed in the latter part of next year.

# ALLIS-CHALMERS




## Consistently better product

### with this continuous mechanical compacting process

Take your process, step by step, and analyze the physical properties you need for better quality and production control. Somewhere along the line you face problems involving granular size, density, solubility . . . feeds, speeds, control . . . additives, binders, flow properties.

Allis-Chalmers helps you maintain control over all of these variables with a continuous compacting process that's the result of years of engineering experience in the chemical industry.

This process produces granules that are more uniform in size . . . granules that flow freer, won't fracture or abrade in handling. Both density and solubility rates are easier to control.

You get greater production economies, too. The process is a simplified, continuous operation. It integrates smoothly into the rest of your system. It requires less auxiliary equipment, less power and lower capital investment than older, less efficient agglomeration methods.

*Applications for this A-C compacting process are virtually unlimited. For complete information on what the process can do for you, contact your A-C representative or write* **Allis-Chalmers,** *Industrial Equipment Division, Milwaukee 1, Wisconsin.* A-1388

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**with Dow Corning Silicone Defoamers***

There's a *right* tool for every job. In foam control it's Dow Corning silicone antifoamers or defoamers . . . job-proved thousands of times over as the most efficient, most economical, and most versatile foam suppressors available.

*At prescribed levels, are sanctioned by FDA

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**and new manual on foam control**

first in silicones

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Please rush a FREE SAMPLE of a Dow Corning silicone defoamer for my product or process, which is (indicate if food, aqueous, oil or other): _____

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POSITION _____

COMPANY _____

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## *Convention Calendar*

**November**

**14-17.** American Institute of Electrical Engineers, Magnetism & Magnetic Materials Meeting, New Yorker Hotel, New York, N. Y.

**14-18.** American Society of Tool Engineers, Western Tool Show & Semi-annual Convention, Ambassador Hotel, Los Angeles, Calif.

**15-17.** Building Research Institute, 1960 Fall Conference, Shoreham Hotel, Washington, D. C.

**15-16.** Purdue University, Symposium on Engineering Applications of Probability and Random Function Theory, Lafayette, Ind.

**16-17.** Oklahoma State University, Industrial Wastes Conference, Stillwater, Okla.

**20-22.** Fluid Controls Institute, Inc., Fall Meeting, Drake Hotel, Chicago, Ill.

**29.** American Institute of Consulting Engineers, Annual Dinner, Waldorf-Astoria Hotel, New York, N. Y.

**29-30.** Midwest Research Institute and CHEMICAL ENGINEERING Symposium on new techniques in mathematics, chemistry and engineering as applied to modern chemical engineering practice, Hotel Muehlebach, Kansas City, Mo.

**27-2.** American Society of Mechanical Engineers, Annual Meeting, Statler-Hilton Hotel, New York, N. Y.

**28-2.** American Society of Mechanical Engineers, 24th National Exposition of Power and Mechanical Engineering, New York Coliseum, New York, N. Y.

**29-2.** Corrosion and Metal Finishing Exhibition, Olympia, London, England.

**30-2.** The Iron and Steel Institute, Symposium on "Steels for Reactor Pressure Circuits," Hoare Memorial Hall, London, England.

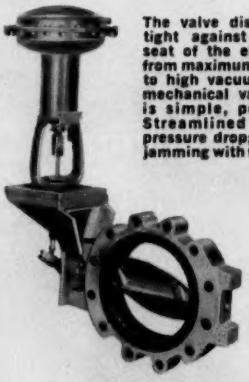
**December**

**1-2.** Ohio State University, 21st Annual Conference on Glass Problems, Columbus, Ohio.

**1-3.** American Chemical Society, 16th Regional Meeting, Biltmore Hotel, Tulsa, Okla.

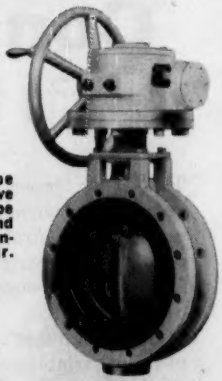
**3-9.** Chemical Specialties Manufacturers Assn., 47th Annual Meeting, Hollywood Beach Hotel, Hollywood, Fla.


# TIGHT CLOSURE is NO PROBLEM with ROCKWELL BUTTERFLY VALVES



The valve disc seats drop-tight against the resilient seat of the elastomer liner from maximum line pressure to high vacuum. Manual or mechanical valve operation is simple, positive, fast. Streamlined design; low pressure drop; no fouling or jamming with foreign matter.

Wafer type butterfly valve with spool type rubber liner, available in "Keelok" snap-in, easily replaceable type or vulcanized to body. Shown with pneumatic operater. Bulletin 583.



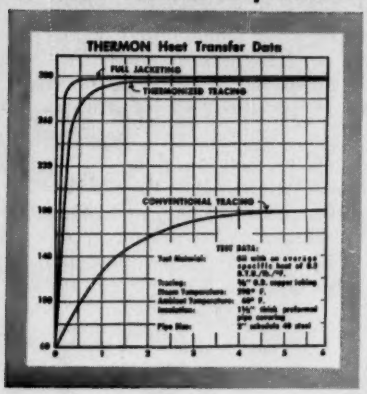
Flanged type butterfly valve with spool type rubber liner and worm gear manual operator. Bulletin 582.

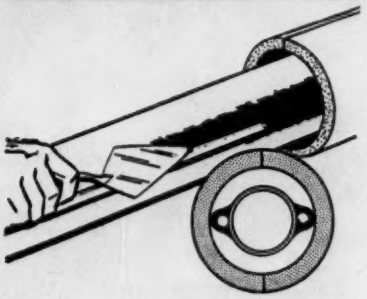
**W. S. ROCKWELL CO.**

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**the proved solution to HEAT TRANSFER problems**



Wherever heat transfer is a problem, non-metallic, adhesive Thermon Heat Transfer Cement, with its highly efficient heat transfer properties, usually can effect a solution. Approximately 5,000 different users, with hundreds of applications, have realized savings of up to 90% with Thermon.

Thermon can easily be applied over both steam tracing and electrical resistance systems, and is equally effective for heating and cooling operations.

Thermon's heat transfer characteristics are approximately *11 times* superior to those of steam tracing, and almost equal those of steam jacketing. Almost without exception, Thermon can be used in place of expensive steam jacketing—and can often be applied where steam jacketing is impossible. Up to 90% of the cost of steam jacketed equipment has been saved through use of Thermon.

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4-7. American Institute of Chemical Engineers, Annual Meeting, Statler Hotel, Washington, D. C.

8. Synthetic Organic Chemical Manufacturers Assn., Annual Meeting, Hotel Roosevelt, New York, N. Y.

11-14. American Nuclear Society, 8th Hot Laboratory and Equipment Conference, Mark Hopkins Hotel, San Francisco, Calif.

11-14. Eastern Joint Computer Conference, New Yorker Hotel, New York.

12-14. U. S. Public Health Service, National Conference, "Problems and Progress in Water Pollution Control," Sheraton-Park Hotel, Washington, D. C.

12-15. Industrial Building Exposition and Congress, New York Coliseum, New York, N. Y.

14-16. Atomic Industrial Forum, Annual Conference, Fairmont Hotel, San Francisco, Calif.

26-31. American Assn. for the Advancement of Science, Annual Meeting, New York, N. Y.

**January**

16-18. American Astronautical Society, 7th Annual Meeting and Convention, Sheraton-Dallas Hotel, Dallas.

16-19. Instrument Society of America, Winter Instrument-Automation Conference and Exhibit, Sheraton-Jefferson Hotel and Kiel Auditorium, St. Louis, Mo.

23-26. 12th Annual Plant Maintenance & Engineering Show, International Amphitheatre, Chicago, Ill.

24-27. Society of Plastics Engineers, Annual Technical Conference, Shoreham and Park-Sheraton Hotels, Washington, D. C.

24-27. Canadian Pulp and Paper Assn., 1961 Annual Meeting of the Technical Section, Queen Elizabeth Hotel, Montreal, Que.

**February**

5-10. National Petroleum Assn. Symposium on Research on Gasoline, Benjamin Franklin Hotel, Philadelphia, Pa.

7-9. The Society of the Plastics Industry, Inc., 16th Reinforced Plastics Division Conference, Edgewater Beach Hotel, Chicago, Ill.

13-17. American Management Assn., Inc., Packaging Management Course, Hotel Astor, New York, N. Y.


# DOES YOUR MIXING EQUIPMENT MEET THESE STANDARDS ?

- Ease in maintenance through simplicity of design
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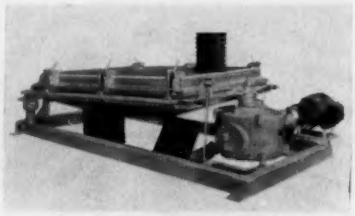
Better Buy BELMONT

THE BELMONT PACKING & RUBBER COMPANY • PHILADELPHIA 37, PA.

NEW EQUIPMENT . . .
*(continued from page 144)*

extinguished. Positive advantage over many other such devices is that hot-wall radiation can not substitute for flame signal, hence cause a false report of burner flame condition.

About the size of a golf ball, the tube can also be used for communications (by picking up invisible ultraviolet ray signals), or to detect gas, smoke and dust. Tube with simplest alarm circuit costs about $20—**McGraw-Edison Co., W. Orange, N. J.** 144C



## Sanitary screener

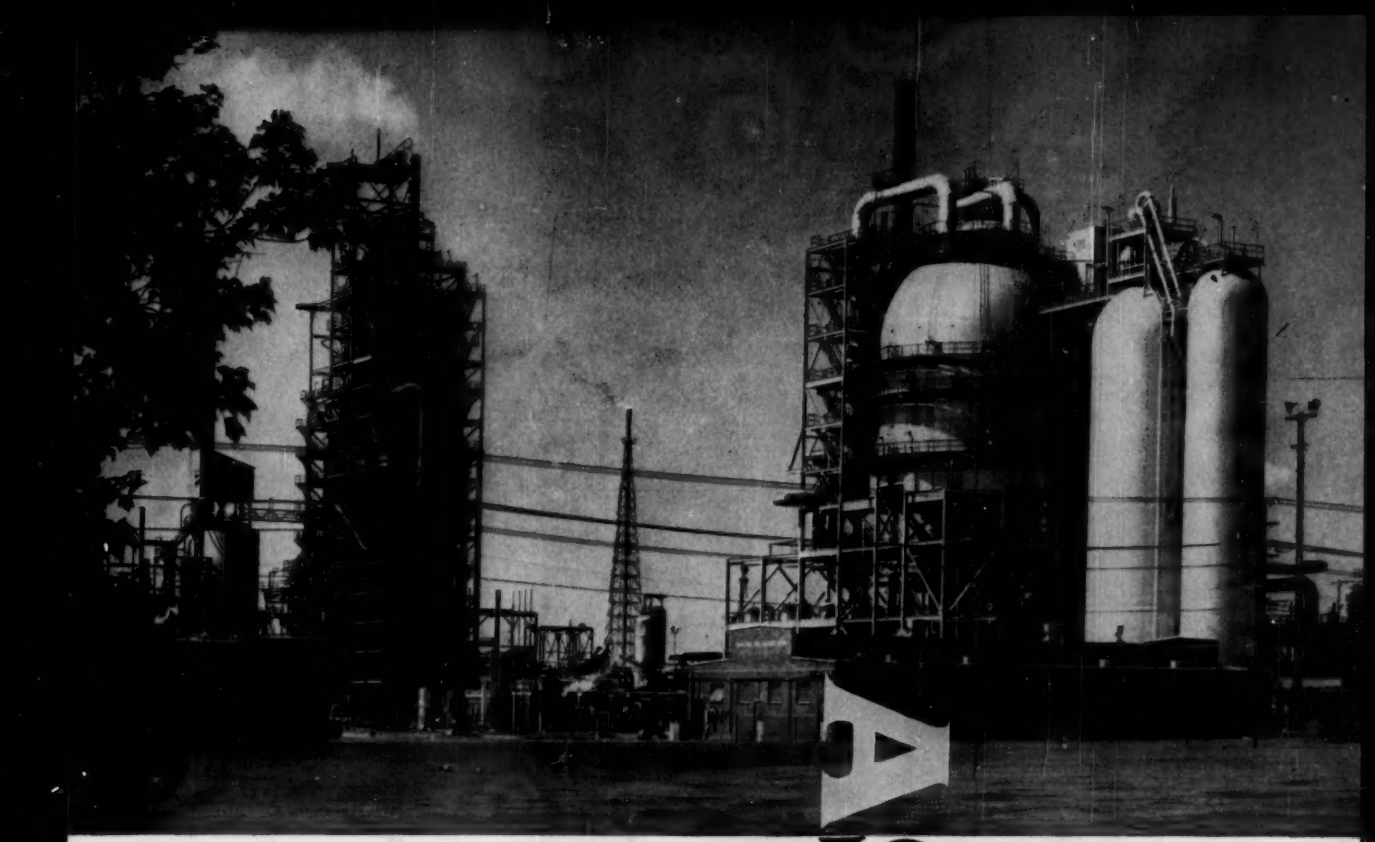
**Screens go on and off quickly with new tensioning frame.**

A new screen frame maintains two-dimensional tension on screen cloth throughout the life of the cloth, according to the manufacturer. Built into a new line of Rotex screening machines, the frame can hold nylon, wire, silk or perforated-plate screens.

Applied in minutes, screen cloth can be removed from the frame instantly by grasping one corner and pulling it away. Dust-tight interior of machine requires no spacer frames, separate partitions or baffles.

Screening action consists of a large circular motion (horizontal plane) at the feed end, which gradually diminished through the length of the machine to essentially straight-line motion at the discharge end. Circular motion distributes feed, and horizontal motion stratifies material, causing coarse particles to float to the top of the bed.

Although basically a sanitary model, Rotex is also applicable



*Low cost, excellent resistance to corrosion:*

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Federated lead products are self-healing; malleable, easy to form and bend; salvable with high scrap value; and probably the most efficient protection you can find for many corrosive chemical conditions. These products include chemical lead sheets to your requirements; pipe, bends, traps and standard fittings available from stock; special forms fabricated to order. Write for Bulletin No. 162, the Lead Handbook for the Chemical Process Industries, to Federated Metals Division, American Smelting and Refining Company, 120 Broadway, New York 5, RE 2-9500; or call your nearest Federated sales office.

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Locust 5250

ST. LOUIS, MISSOURI
Jackson 4-4040

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Empire 4-3601

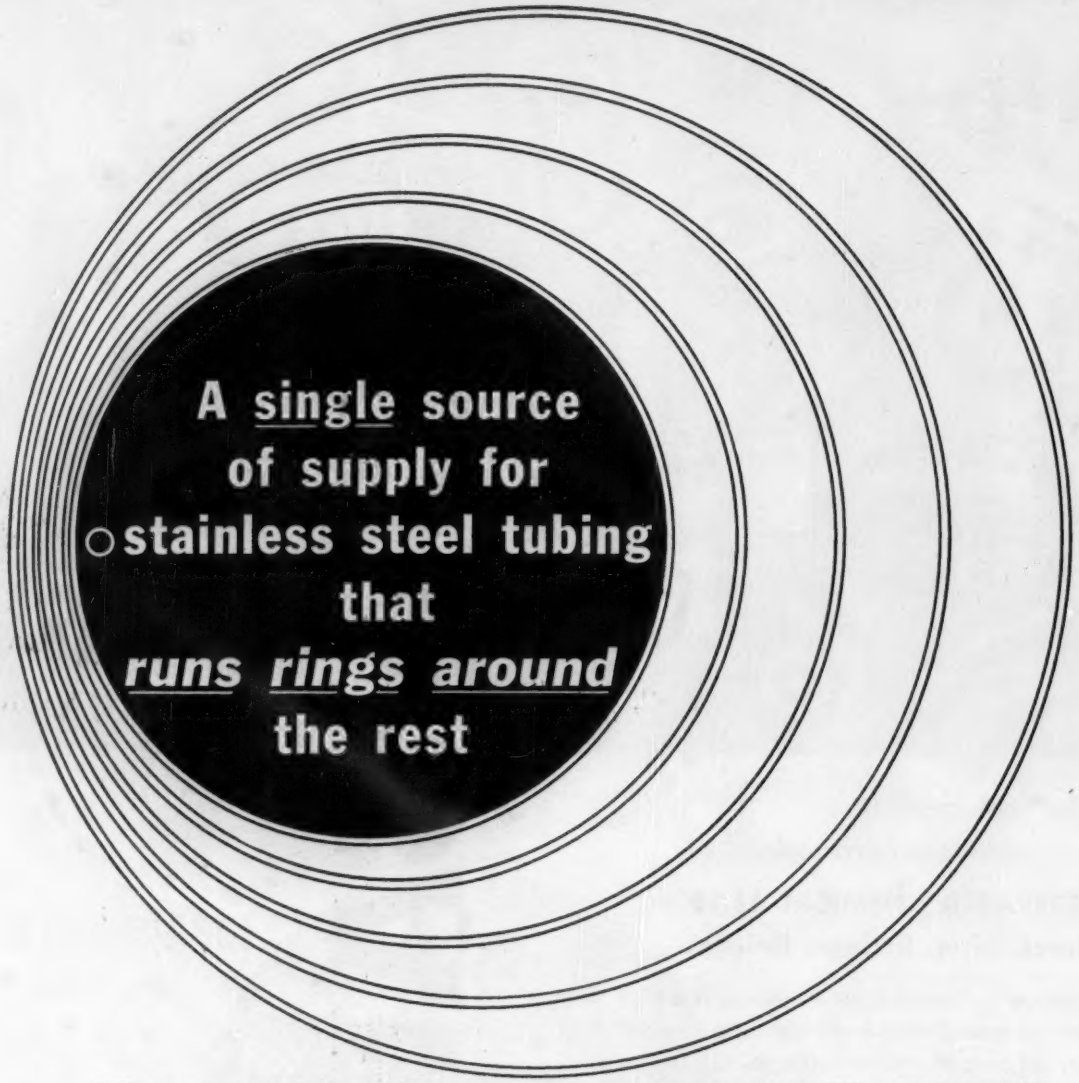
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Widest range of fusion welded pipe and tubing available—bright annealed or pickled finishes.

Lengths up to 60 feet. 1/8" to 6 5/8" O.D. Wall thickness from .008" to .154" depending upon O.D. and application.

For every need . . . aviation applications, ornamental, architectural, mechanical and high-temperature uses, pressure flow lines, sanitary processing . . .

And for quality assurance . . . complete X-ray, ultrasonic and Eddy Current equipment . . . tensile tests, automation gaging, laboratory samplings.

*Why not purchase your stainless steel tubing and pipe where tonnage is produced on a laboratory basis? Write for new folder on stainless steel tubing.*

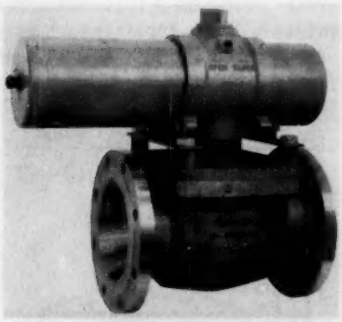
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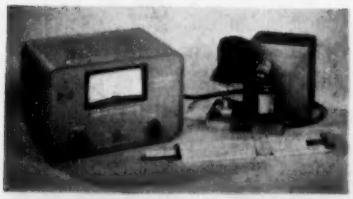
wherever frequent screen changes must be made.—**The Orville Simpson Co., Cincinnati.** 274A



## Actuated ball valve

**Top-loading valve, spring-loaded, returns to set position.**

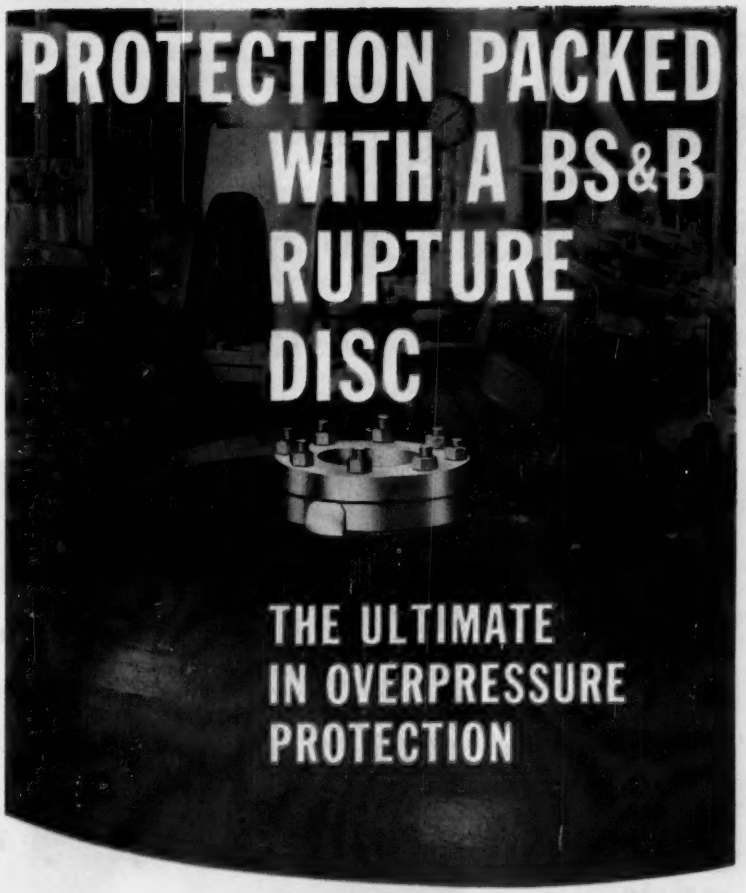
Top-loaded for easy access to the internal assembly, a new air-actuated ball valve has a spring return that can be set to either open or close the valve in case of air failure. Rated at 150 lb. ASA, valve is available in carbon or stainless steel. Ball is guided on top and bottom, operates by quarter-turn actuation. Available only in 8-in. size.—**Hydromatics, Inc., Bloomfield, N. J.** 277A



## Process regulator

**Electronic device regulates flow, controls temperature.**

A new electronic process regulator can be used as a flow regulator, a precision valve positioner or a temperature control. Shown in the photo is a pressure regulator that can control pressure either upstream or downstream of the control valve, or at remote points in the flow system. Three


**If you have a pressure system equipped with a relief valve you will want this added safety measure.**

BS&B Rupture Discs act fast providing an unrestricted relief opening. Discs are available in sizes ranging from ⅛" to 44" in diameter, covering rupture pressures from 3 to 100,000 PSI.

Specially engineered discs (DV) provide relief under a wide range of operating conditions including high tolerances—high temperature — pulsating pressure or alternating pressure and vacuum situations.

BS&B Rupture Discs (Safety Heads) are likewise available in a wide combination of special materials and plastics to accommodate system requirements.

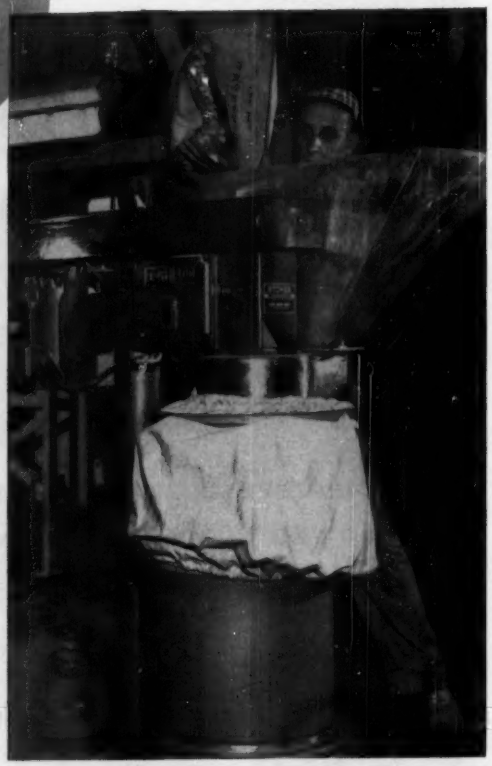
Let our engineers evaluate your pressure system and help you select the proper Safety Head or write to: BLACK, SIVALLS & BRYSON, Inc., Safety Head Division, Dept. 2-N11 7500 East 12th Street, Kansas City 26, Mo.

BS&B

**BLACK, SIVALLS & BRYSON**

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# 5 big reasons why Pennsalt chose the Stokes tornado mill...



- **Versatility**
  in speed, in size of particles it handles, in the rate of production, in the different basic materials with which it can be used
- **Portability**
  Pennsalt uses it in several different locations throughout the plant
- **Easier-To-Clean**
  Tornado Mill can be cleaned in 1-hour. It formerly took a full day to clean the size reduction equipment
- **360° screen**
  provides full working area
- **Minimum Maintenance—**
  Only two spare parts required

Pennsalt uses the Mill in size reduction of dry Sal Ammoniac and dry Actidip*.

Whatever you are contemplating, investigate the Stokes Tornado Mill. More and more companies everyday are learning the new way to "size reduce".

The Stokes Advisory Service will be glad to run tests on a sample of your material. Call or write . . . today.

*Registered tradename

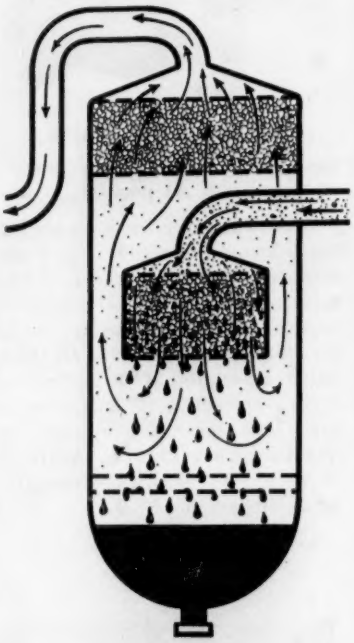
*Size Reduction Equipment Division*
F. J. STOKES CORPORATION
5500 Tabor Road, Philadelphia 20, Pa.

**STOKES**




models cover the range from 30-in. of Hg vacuum to 5,000 psi.

Basic elements of the unit include a servo-controlled valve, an electronic control amplifier and a pressure transmitter. Operating error (difference between actual pressure and set point) can be as small as 0.006 psig. Prices range from $650 to $1,700.—**Physics For Industry, Rochester, N. Y. 277B**



## Air filter

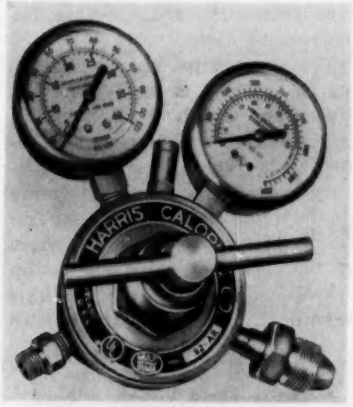
**New principle used to give air a scrub-and-polish treatment.**

Designed to remove almost 100% of entrained dirt, oil and water from 20 to 200 cfm. of air, a new filter contains two disposable cartridges—a departure from conventional filter arrangement.

In operation, incoming air flows downward into the filter through a wet-bed cartridge that removes dust and dirt particles down to 2 microns. Mist and fog particles of oil and water passing through the wet filter coalesce into large drops and fall out into the bottom sump as the air changes direction to go up into the second cartridge.

The dry-bed polisher cartridge

removes practically the last remaining traces of water and oil. Since the scrubber (first) cartridge does 98% of the cleaning, the polisher cartridge has an extremely long life. Scrubber cartridge also has long life, since it is swept clear of excess liquids by incoming air.—**King Engineering Corp., Ann Harbor, Mich. 278A**




## Metering regulator

**Actual flow rate in cfh. is continuously shown on dial.**

A new gas regulator not only closely controls the pressure of flowing gas but also records the actual flow rate on a second dial. According to the manufacturer, the regulator is unusually accurate because there are no gaskets to loosen. Unit can be mounted in any position without affecting flow accuracy.

Gases that are normally handled by the regulator include oxygen, carbon dioxide, helium, nitrogen, argon, hydrogen, propane and acetylene.—**Harris Calorific Co., Cleveland. 279A**

## Dewpoint instrument

**Relative humidity and dewpoint units have patented sensor.**

A new line of relative humidity and dewpoint instruments gives accurate readings regardless of


# SENSITIVE SENTINEL

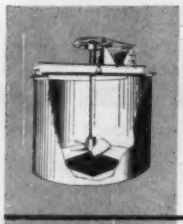
is a good description of the Barton 257 differential pressure indicating switch. Accurate, responsive, easy to read and infinitely dependable, the 257 is ideal for energizing alarm circuits when limits of flow, level, or differential pressure are exceeded. Like many Barton instruments, the 257 D.P. switch has as its heart the rupture-proof dual bellows Barton meter body—proved beyond doubt to be the finest in the field. For new standards of accuracy and dependability in your measurement and control instruments, look to the leader—buy **BARTON**®




**BARTON INSTRUMENT CORPORATION • MONTEREY PARK, CALIFORNIA**

# DENVER Equipment

## FOR THE CHEMICAL PROCESS INDUSTRY

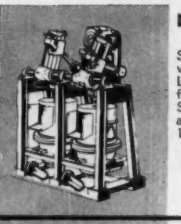


**DENVER AGITATORS AND MIXERS**

Agitator types available: Turbine-type propeller (to 120" in tanks to 50' dia.), slow speed, high speed, air lift, vertical turbine mixers, mixer-settler units.

**Write for Bulletin No. A2-B2**

Lab and pilot scale agitators in LG3-B10

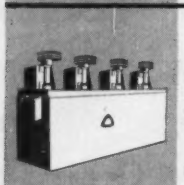


**DENVER DIAPHRAGM PUMPS**

Stroke can be adjusted while pump is operating. Long wearing nylon-reinforced rubber diaphragm. Sizes 1" to 10" simplex and duplex, capacity to 1000 g.p.m.

**Write for Bulletin No. P8-B12**

Lab and pilot scale diaphragm pumps in LG3-B10

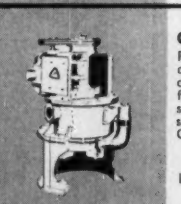


**DENVER ATTRITION SCRUBBERS**

High power input to efficiently remove sand coatings, mix dense slurries. Rubber lined or acid-proof tanks. Sizes to 56" x 56"

**Write for Bulletin No. A-B505**

Lab and pilot scale scrubbers in LG3-B10

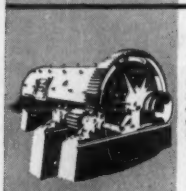


**DENVER VERTICAL CENTRIFUGAL PUMPS**

For handling frothy liquids or coarse, sandy slurries, constant or intermittent flow. No packing gland or sealing water. Standard or stainless steel construction. Capacity to 450 g.p.m.

**Write for Bulletin No. P10-B5**

Lab and pilot scale vertical centrifugal pumps in LG3-B10

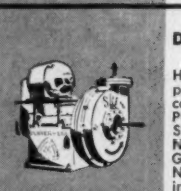


**DENVER BALL AND ROD MILLS**

Offer operation and convertibility. Wet or dry grinding systems. All steel construction. Ceramic or rubber linings available. Sizes to 10'x 20'.

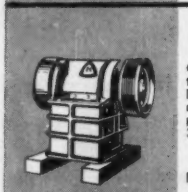
**Write for Bulletin No. B2-B20**

Lab and pilot scale mills in LG3-B10



**DENVER SRL (RUBBER LINED) PUMPS**

High efficiency, low horsepower. Parts last longer, cost less. Rubber lined. PUMPS AND PARTS IN STOCK. Sizes to 5000 g.p.m. Now available in "TRU-GLANDLESS" construction. No sealing water. No packing glands. No slurry dilution. **Bulletin P9-B28.**

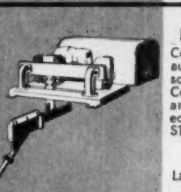


**DENVER JAW CRUSHERS**

Cast steel frame, anti-friction side bearings and bumper bearings. Manganese steel jaw and cheek plates. Sizes from 2¼"x 3½" to 36"x 48".

**Write for Bulletin No. C12-B12**

Lab and pilot scale crushers in LG3-B10



**DENVER SAMPLERS**

Continuous mechanical and automatic types for dry, solution or slurry sampling. Complete sampling plants and sample processing equipment. SAMPLERS IN STOCK.

**Write for Bulletin No. S1-B4**

Lab and pilot scale samplers in LG3-B10



**DENVER REAGENT FEEDERS**

Both wet and dry feeders available. Let us know your requirements. Many standard units in stock.

**Write for Bulletin No. F6-B8**

Lab and pilot scale feeders in LG3-B10

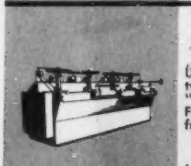


**DENVER-DILLON SCREENS**

For efficient wet or dry screening. "True-Circle" eccentric action. Sizes to 6'x 14' in stock. Also Trommel Screens in sizes from 30"x 60"x 120".

**Write for Bulletin No. S3-B15**

Lab and pilot scale screens in LG3-B10



**DENVER "SUB-A" FLOTATION**

Universal tank with three types of mechanisms: (a) "Cell-to-Cell"; (b) "Free-Flow"; (c) Type "M". Sizes from 16"x 16" to 72"x 72".

**Write for Bulletin No. F10-B86**

Lab and pilot scale flotation in LG3-B10



**DENVER SPIRAL RAKE THICKENERS**

Move settled materials to center in one revolution. Simple, efficient, heavy-duty gear mechanism for thickeners to 150' dia. Acid proof construction available.

**Write for Bulletin No. T5-B6**

Lab & pilot scale thickeners in LG3-B10

**DENVER EQUIPMENT COMPANY**

**Box 5268, Denver 17, Colorado**

**Phone CHerry 4-4466**

SEE OUR CATALOG ON PAGES 949-956 IN C.E.C.

**DENVER TESTING FACILITIES**

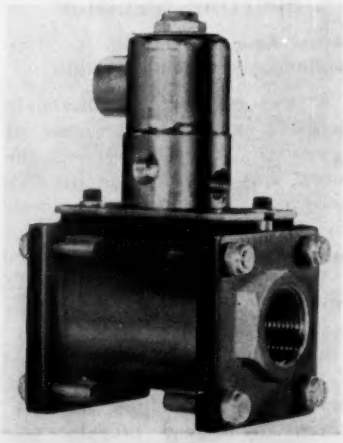
You will have problems in crushing, grinding, settling and possibly concentration and filtering. These are our specialties so please let us help you in our Test Department. Deco flowsheets are reliable and proven.




flow rate, according to the manufacturer. Suitable for continuous readout or random sampling, units measure dewpoints as low as —240 F. in a few seconds.

Heart of the new line is a patented sensor, developed in England, that is unaffected by most dust and atmospheric conditions. It consists of a wire coated with a hygroscopic dielectric layer that is in turn coated with permeable gold. The capacitance of the dialectric layer varies with moisture content, is indicated on the instrument dial.

The sensing probe and indicating instrument may be hundreds of feet apart without affecting the reading. Probe is only 1-cm. in diameter by 6 cm. long; it is protected by a 100-mesh stainless steel screen, has a life of several years and can withstand pressures up to 2,000 psi. Units operate on 115-v., 60-cycle power.—**Atkins Technical, Inc., Cleveland. 279B**



## Flexible-sleeve valve

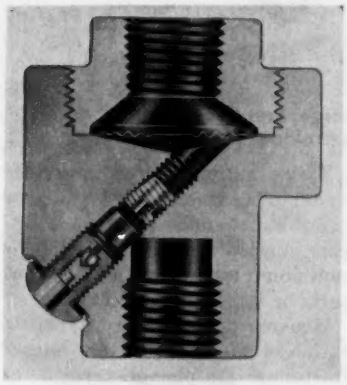
**Rubber sleeve, controlled by air pressure, controls liquid flow.**

Sealing at pressures up to 200 psi., a new valve consists of an outer housing and an inner rubber, cylindrical seal. In normally-open-type valve, sleeve is relaxed against the inner surface of tube, and flowing fluid passes through the inlet port, through the sleeve,

and out the outlet port.

To close the valve, air pressure is applied between the inside diameter of the tube and the outer periphery of the rubber sleeve. Pressure collapses the sleeve over the rounded ends of the inlet and outlet plugs, effectively sealing off the flow. Only action is the flexing of the sleeve.

Valve available in pipe sizes from ¼ to 12-in., with valve either normally open or closed.—**Airmatic Valve, Inc., Cleveland. 280A**



## Gage accessories

**Units protect gage from pulsation and corrosive chemicals.**

Two new pressure-gage accessories, similar in basic design, protect gages from effects of pulsating pressure and corrosive chemicals.

Both units have a stainless-steel or neoprene diaphragm that separates the measured fluid from the gage measuring element. Space above the diaphragm is filled with a viscous, nonfreezing liquid that transmits the measured pressure to the element. For pulsation dampening, there is an adjustable restriction in a passage from the diaphragm top to the gage.

Gages equipped with the dampener can be used with fluid temperatures between 50 and 100 F., without temperature correction. Outside this range, a gage must be calibrated at the specific temperature. The chemical attachment

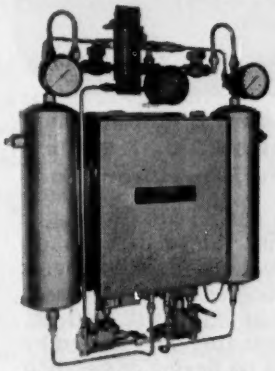

LOW COST, DEPENDABLE INSTRUMENT AIR-

TRINITY

Heat-Les



Increase dependability and accuracy of measurement and control in your system by specifying a dependable Trinity Heat-Les Dryer. These amazing dryers, operating on a principle so simple, yet so efficient, are establishing unparalleled operating records in over a thousand installations.

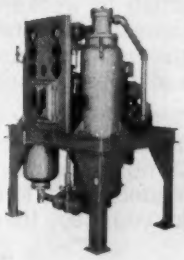


Trinity Heat-Les Dryers are available in standard models ranging from 2 SCFM to 5000 SCFM. Units up to 200 SCFM are available from stock.

★ Low initial cost
★ Completely eliminates costly electric or steam heaters
★ No increase in effluent gas temperature
★ Low installation costs
★ Low operating and maintenance costs
★ Built-in safety system provides dry air for extended period after power failure.

ALSO HEAT-REACTIVATED DRYERS

Trinity also offers a complete range of capacities in heat-reactivated type dryers of an advanced design, offering the greatest economies and performance for this type dryer... **WRITE FOR COMPLETE TRINITY DRYER AND ACCESSORY TECHNICAL MANUALS...**

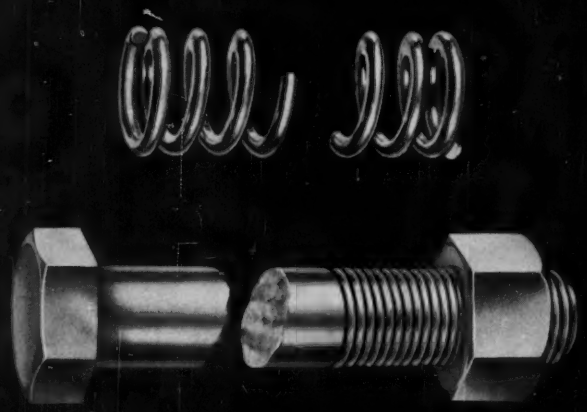


TRINITY World leader in dry gas/air systems

Heat-Les Dryers • Heat-reactivated Dryers
Thermocouples and Thermowells

TRINITY EQUIPMENT CORPORATION, CORTLAND, NEW YORK

Are broken springs,
broken bolts,
or valve noises giving you
COMPRESSOR HEADACHES?

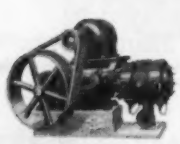


**here's why the simple design of the air cushion valve makes PENNSYLVANIA COMPRESSORS run efficiently...silently...with minimum maintenance.**

Stainless steel valve discs lift against a cushion of air in the simple, efficient design of the Air Cushion Valve that makes PENNSYLVANIA Compressors run so silently, so dependably, and with such low maintenance requirements. Air Cushion Valves have no nuts, bolts, or screws to break or burn fast. You get longer valve life . . . eliminate wear . . . eliminate noise caused by metal striking metal. Flat valve discs have no flexing or bending action to weaken or distort them. And the valve springs are highest grade stainless steel, rolled on edge, insuring maximum strength and durability. There is just one spring for each disc, and it bears evenly on the entire surface.

But this is only part of the PENNSYLVANIA story. Learn all the facts in "Compressors for Industry". It describes PENNSYLVANIA Compressors from 10 to 350 hp, horizontal, angle, and OILFRE models. Write to Dept. A-11 for your copy today.

**PENNSYLVANIA**
PUMP AND COMPRESSOR COMPANY
Easton, Pa. • Earning Customer Confidence Since 1920

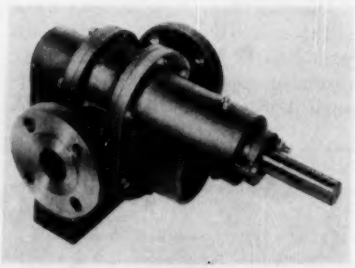






NEW EQUIPMENT . . .

may be mounted directly to the gage socket or located remotely and connected to the gage via capillary. — **U. S. Gauge, Div. of American Machine and Metals, Inc., Sellersville, Pa.** 281A



## Gear pump

**Large unit features an extralong stuffing box.**

Twice as big as the previous model in the line, a new 1½-in. gear pump can handle flows up to 27 gpm. Called Gearchem, pump is available either with threaded ports or integrally cast flanges.

Housing and shaft are Type 316 stainless steel, gears are either Hastelloy C, phenolic resin or nylon. An extralong stuffing box is equipped with a lantern ring that may be sealed with a chemically inert sealant and lubricant, or connected to a pressure flush.

Pump speed (dependent upon fluid viscosity) ranges to 1,200 rpm. At discharge pressures to 150 psi., metallic-gear units withstand 400 F. Phenolic or nylon gears are good to 150 F.—**Eco Engineering Co., Newark, N. J.** 282A

## Hydrogen plant

**Compact unit produces 98%-pure $Hydrogen_2$ in two-stage process.**

Relatively pure hydrogen at low cost is claimed for a new, compact plant that can produce hydrogen from 82 to 98% purity, the balance being nitrogen.

The first stage of the two-stage process separates commercial anhydrous ammonia into hydrogen

*Textile Technology in Chemical Engineering*

# The Final Test of a Filter Fabric

While appreciating the factors involved in the development of filter fabrics from fiber to finish, the practical processing engineer wants to get down to cases to see how filter fabrics perform under the acid tests of specific application.

A typical "acid test" may be found in the dyestuffs industry, where a dye intermediate is separated from a sulphuric and hydrochloric acid solution at 45 degrees C. This process, so corrosive that the filter press must be made of rubber-coated aluminum, successfully utilizes a spun dynel filter fabric designed for high chemical resistance, efficiency and durability.

Acids, of course, are not always the problem. A yeast manufacturer required a filter medium which would provide adequate flow while retaining very finely-divided yeast particles, would be smooth enough for easy cake discharge and sturdy enough to withstand filter press wear and frequent cleaning. A specially constructed cotton duck of close, firm texture proved the highly satisfactory and economical answer.

To get complete information about filter fabrics, make sure you consult a specialist. The specialists who distribute Wellington Sears filter fabrics are fully equipped to help you select the medium that best answers your problems. Behind them, they have our 114 years of experience in providing quality fabrics to industry. For distributors' names, and informative booklet, "Filter Fabric Facts," write Dept. L-11.

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# NO. 1 REASON



*this is the ideal valve for high-speed pumps*

Key to the high efficiency and free action of a DURABLA V-7* Pump Valve Unit is the patented lightweight valve member. Making only "point contact" on the sleeve, it can't bind or hang up. Nor can it warp, thanks to its unique arched design.

This low-lift valve member is designed to open with a tilt, following the flow lines. Valve action is very sharp, thanks to lightness and flexibility. That's why DURABLA is the only valve ideally suited to high-speed operation.

DURABLA valve units operate freely under temperature-pressure extremes, with corrosive fluids and in any position. Available in 17 sizes, they will meet over 300 variations in installation requirements.

Send for booklet CE110

**DURABLA MANUFACTURING COMPANY**
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DM-35

*Patent applied for

DURABLA®

Manufacturers of DURABLA sheet packing, gaskets and check valves

and nitrogen with a conventional ammonia dissociator. The second stage employs a continuously cycling adsorption process to separate the two gases. Only inputs to the process besides the feed are gas or oil fuel, electrical power and a little cooling water.

Plant size ranges from 750 to 10,000 scfh. All the equipment for the 750-scfh. plant (except dissociation portion) will fit on a steel skid, 6 × 12 ft., can be shipped completely piped and wired.

The system can be started up quickly, can operate in any range from 25% to full capacity without affecting the quality of the product or the efficiency of the plant. Hydrogen cost is somewhat higher in the upper purity ranges due to the somewhat reduced output.—**The Electric Furnace Co., Salem, Ohio.** 282B

## *Briefs*

**Tiny temperature recorder** uses unamplified signal from thermocouple. Pointer on the moving coil is clamped every 4 sec.; marker on pointer then scores pressure-sensitive chart paper. Chart roll lasts 31 days at 1 in./hr., in 3½-lb. unit. —**Assembly Products Inc., Chesterland, Ohio.** 284A

**Ball valve** has bronze body, screw ends, Teflon or Buna-N seats and seals. Removable cover allows top entry access to the ball, which is flat on top and bottom to allow easy removal and quick access to seats. Handle is designed to act as hook to remove ball.—**Lunkenheimer Co., Cincinnati, O.** 284B

**Safety goggle** has soft-rolled edges, fits the face securely. Acid-resistant molded rubber has aluminum vents for welders and chippers, solid construction for chemical workers. Fits over regular eyeglasses.—**Bausch & Lomb Inc., Rochester, N. Y.** 284C

**Dux-Sol** is a new material for lining drums and pails used as con-

tainers for sticky materials. New release coating is said to work with almost any sticky product that resists removal from regular containers. — **Resisto Chemical, Inc., Wilmington, Del.** 284D

**Centrifugal selector,** which selects fines in the low micron range, is now available in 3- and 6-ft. dia. Device recovers micron-sized fines said to be impossible to classify with standard air separators. Feed material falls on a rotating disk, which distributes it around an interior chamber. Ascending air carries material upward through a multivane rejector that deflects unwanted fines.—**Sturtevant Mill Co., Dorchester, Boston.** 285A

**Stainless steel tubing** for gas chromatography columns is now available in three types—capillary, miniature and packed. Advantages claimed for the tubes include good corrosion resistance, uniform and smooth I.D., ability to withstand high process temperatures.—**Superior Tube Co., Norristown, Pa.** 285B

## Equipment Cost Indexes . . .

| | June 1960 | Sept. 1960 |
|---|---|---|
| **Industry** | | |
| Avg. of all | 238.2 | 237.4 |
| **Process Industries** | | |
| Cement mfg. | 232.8 | 231.7 |
| Clay products | 226.2 | 225.6 |
| Glass mfg. | 226.6 | 225.3 |
| Paint mfg. | 229.8 | 229.1 |
| Paper mfg. | 231.3 | 229.9 |
| Petroleum ind. | 234.1 | 234.0 |
| Rubber ind. | 237.6 | 236.9 |
| Process ind. avg | 236.5 | 236.2 |
| **Related Industries** | | |
| Elec. Power equip. | 242.7 | 240.2 |
| Mining, milling | 241.5 | 240.0 |
| Refrigerating | 268.5 | 267.7 |
| Steam power | 225.0 | 224.3 |

Compiled quarterly by Marshall and Stevens, Inc. of Ill., Chicago, for 47 different industries. See Chem. Eng., Nov. 1947, pp. 124–6 for method of obtaining index numbers; April 4, 1960, pp. 149-50 for annual averages since 1913.


# *FRICK ACCEPTS COMPLETE RESPONSIBILITY*

## when we contract to install our air conditioning or refrigeration systems

WHEN FRICK designs, manufactures and installs an air conditioning or refrigeration system of *any* size . . . *it works.* We guarantee that by written contract; no excuses, no alibis, no putting the blame on any component manufacturer.

Because of our complete and unique engineering service, the pride we take in our work and our 107 years of experience, we have . . . with the cooperation of architects, consultants, and contractors . . . designed, installed and *guaranteed* air conditioning and refrigeration systems of all types . . . for hotels, restaurants, stores, office buildings, hospitals, processing and industrial plants.

Write for estimates. Better yet, a FRICK engineer will be happy to discuss your problem with you. No obligation.

**FRICK COMPANY**
**Waynesboro, Pennsylvania**

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## Nicholson Thermostatic Steam Traps



These traps are only a fraction of your steam equipment cost . . . yet they can do a whale of a job in helping you to get full efficiency from that equipment even with varying pressures. Here's how.

Operating on a true balanced vapor-pressure principle, they discharge air, condensates and other non-condensables promptly, fully and intermittently. What's more, the bellows is located where it belongs . . . at the trap top . . . so that when live steam enters it contacts the bellows the moment the discharging condensate falls below the top of the inlet pipe. Thus, there is a constant water seal to prevent loss of live steam. This, plus the fact that valves and seats are accurately lapped for sure, safe shut off assures you of full thermal efficiency from every pound of steam. Capacity? These traps have it . . . up to six times greater than ordinary traps. Also since there's only one moving part . . . no links, pin, levers . . . your maintenance cost is next to nothing.

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## *Technical Bookshelf*

**What's New in Technology?**

ENCYCLOPEDIA OF CHEMICAL TECHNOLOGY — SECOND SUPPLEMENTARY VOLUME. Editor: Anthony Standen. Interscience Publishers, New York. 970 pages. $25.

Later this month, *Chemical Engineering* is cosponsoring with Midwest Research Institute a conference on the new disciplines and new engineering tools. Part of the two-day program will be devoted to "The New Chemistry." And new it is for anyone out of school for more than five years.

We, on *CE*, have recognized the significance of the fantastic growth in the chemistry that's the basis for our chemical process industries. We realize the importance of keeping in step with progress being made on the frontiers of our knowledge and in the modern chemical plants across our nation.

If you need convincing that I'm not elaborating, I've an exhibit to impress you with this progress. It's the second supplementary volume of Kirk-Othmer's Encyclopedia of Chemical Technology. In it are 59 articles that sandwich between or augment those of the regular 15-volume encyclopedia.

I'm sure your most casual perusal will convince you that chemistry and technology are advancing faster than any one person can keep up with. And here, in this reference, are both intellectual stimulation and technological guidance.

Do you want a measure of your own unawareness? Answer these questions:

- What compound acts as a perfect gas?
- What resins lack significant biochemical oxygen demand?
- Why should thermodynamics be called "thermostatics"?
- What are solions? Why are they important to the deaf?
- How did radioisotopes save $42.7 million in cigarette manufacture during 1958?
- What are polyoxetanes and why are they used in pipe linings?
- Why are polycarbonates used for grommets?

• Which class of surface-active agents represents "one of the most versatile and varied groups of surfactants in our American economy today?"

• What are pathfinder elements?

• What are the two major advances during the last ten years in the field of cryogenics?

• What's complexometry? (It rates 17 pages in the new volume)

• How much instant coffee is made annually and what are the engineering features of its production?

• What natural high molecular weight polymer resembling cellulose is insoluble in water, dilute acids, dilute and concentrated alkalis, alcohol and all organic solvents?

• What is chemical coding, its status today, and how does it fit into automation procedures?

• What new compound can unmask morphine addiction promptly and also reveal duration of addiction?

• What's "inorganic benzene"?

• What's new in electric cells? Fuel cells?

Have I piqued your curiosity? Such was my intention. If I've failed in emphasizing our amazing progress in theory, techniques and technology, steal a quick glance at the comprehensive index of this volume. The nature of the entries will convince you of the accuracy of my thesis. And in the completeness of the index, its scope and variety, you'll recognize the tremendous scope of "new" chemistry.—LBP

**In Rapid Review**

*The Surface Chemistry of Metals and Semiconductors.* Ed. by H. C. Gatos, J. W. Faust, Jr., and W. J. LaFleur. John Wiley and Sons, New York. 526 pages. $12.50. The vital field of surface chemistry encompasses subjects as diverse as wear, electrode processes and catalysis; and joint symposia have become an important means of communication. This book consists of the proceedings of such a symposium, sponsored by the Office of Naval Research and the Electrochemical Society, and contains 23 original


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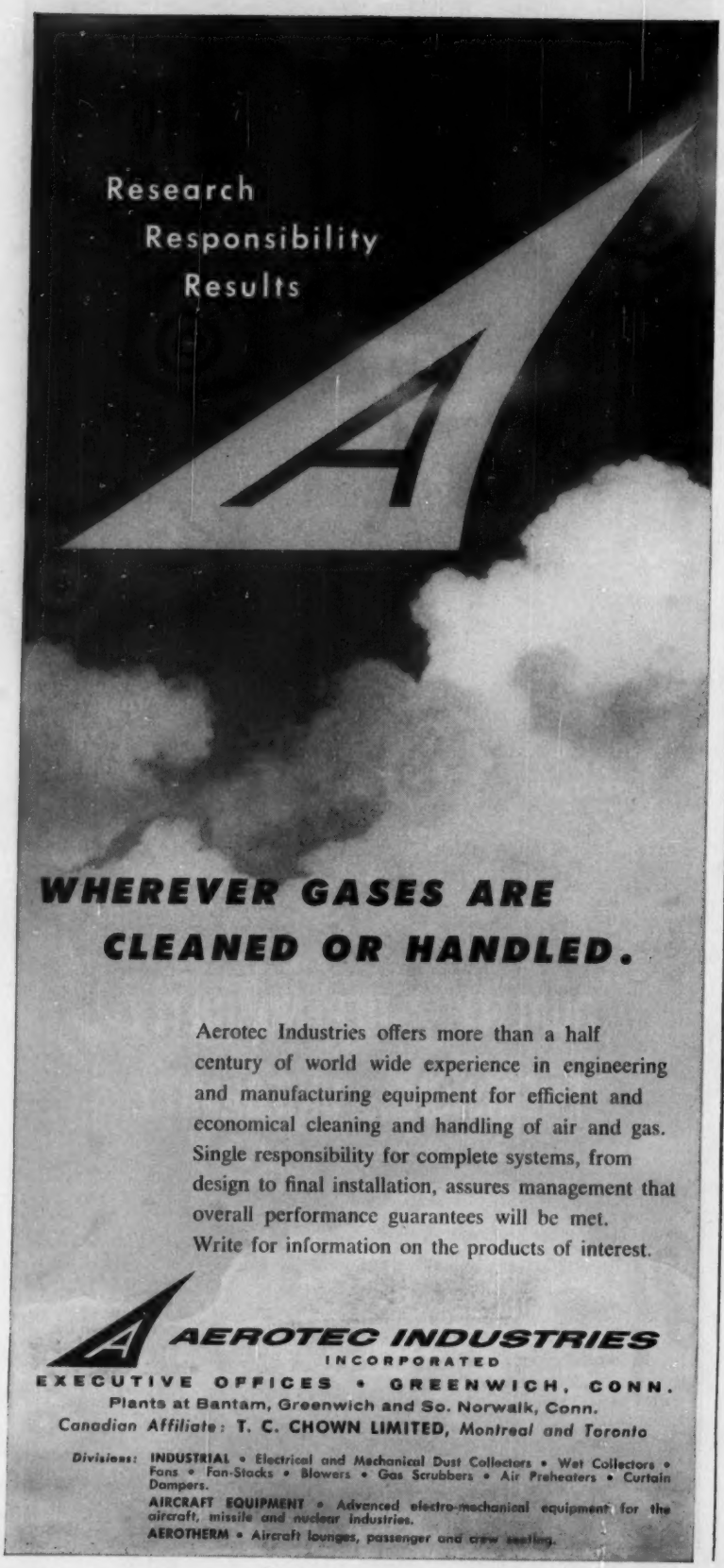
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papers and the transcripts of the discussion of each. The papers show the impact that solid-state research has had on surface chemistry, and the international list of contributors includes many of the best-known younger workers, as well as Nobel Prize winner Brattain.

*Quantitative Inorganic Analysis.* 2nd ed., rev. by R. Belcher and A. J. Nutten. Butterworth and Co. (Canada) Ltd. 390 pages. $7. Directed at the undergraduate in a "practical" analytical course, this up-to-date volume covers in a thorough and workmanlike manner a variety of analytical procedures for a restricted number of the common elements. Emphasis is on a high standard of laboratory technique, both mental and physical.

*Calculations of Analytical Chemistry.* 6th ed. L. F. Hamilton and S. G. Simpson. McGraw-Hill Book Company, New York. 334 pages. $5.95. Several generations of undergraduate analytical chemists have polished up their slide rules with this text, which in its present form covers essentially all the calculations of concern to an analyst, including those involving statistics, reaction rates and electromechanical methods, as well as the old standbys. Elementary, but a handy reference even for veterans, who may perhaps be a bit rusty.

*Introduction to Quantum Field Theory.* By F. Mandl. Interscience Publishers, New York. 202 pages. $6. Knowledge of nonrelativistic quantum mechanics, the special theory of relativity, and the Dirac theory of the electron, is assumed. With this basis, the reader is introduced to the ideas of field quantization and the solution, by perturbation methods, of problems in scattering, annihilation, and other types of particle interactions.

### More New Books

*Water Supply: Economics, Technology and Policy.* By J. Hirshleifer, J. C. De Haven and J. W. Milliman. The U. of Chicago Press. $7.50.

*Thermoelectric Materials and Devices.* Ed. by I. B. Cadoff and E. Miller. Reinhold. $9.75.

*Advanced Organic Chemistry.* 3rd ed. By G. W. Wheland. Wiley. $17.50.

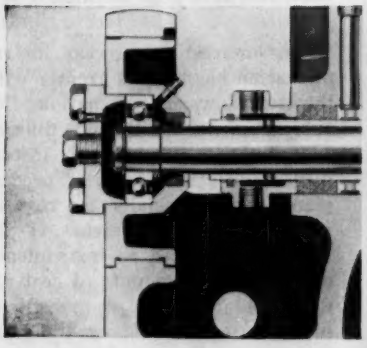
*Thermoelectricty.* Ed. by P. H. Egli. Wiley. $10.

*Waste Treatment.* Ed. by P. C. G. Isaac. Pergamon Press. $15.

*Food for America's Future.* By twelve authors. McGraw-Hill. $3.95.

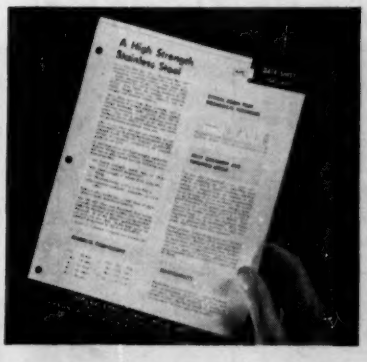
# PUMPAGE

**Goulds news about pumps for process industries**



### When life hangs by 5/1000 of an inch

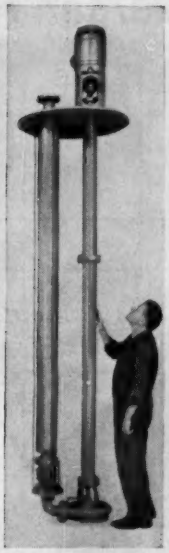
Whether life is long or short depends on the proper fit of shaft to bearing. Destroy the fit by 5 to 10 thousandths of an inch—and you shorten bearing life. Therefore Goulds pump shafts are ground and polished to within the tolerances specified by bearing manufacturers. To insure complete accuracy, bearing housings are bored by a special machine. Careful handling when removing and replacing bearings in the field will also go a long way toward protecting fit and helping bearings live to a ripe old age.




### Now... ISO-40 to guard against corrosion and abrasion

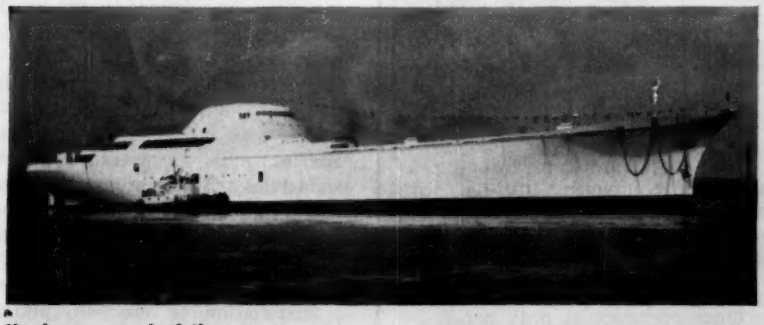
A stainless of great strength, ISO-40* alloy survives under some very harsh conditions. Strongly oxidizing nitric solutions don't faze it. It's a match for 50% sulfuric at r.t. It resists corrosion, abrasion, high shock. Can be furnished with a B.H.N. hardness of 320, tensile strength of 145,000 psi. A pump with an ISO-40 impeller circulated a slurry of sodium sulfite and sodium carbonate for 17 months with negligible impeller damage. Speaking of pumps, did you know you can get Goulds chemical pumps in ISO-40?

*Registered trademark of Empire Steel Castings, Inc.



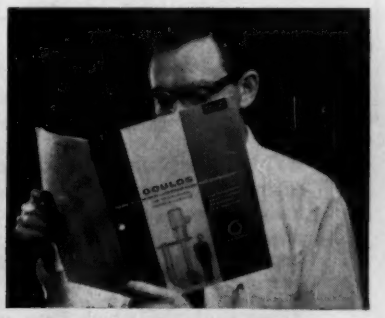
### Circulating crude phthalic anhydride

One company does it with two Goulds Model 3171's. Each delivers forty gallons a minute of this sluggish solid (sp. gr. 1.2) from a depth of 11 ft. at temperatures from 300 to 525 F. How? The discharge pipe, which extends from pump through pit cover, wears a steam jacket. Temperature stays up—phthalic anhydride stays fluid. The long pipe has a 3″ expansion joint. Additional steam-jacketed pumps of other and varying lengths give flexibility to the installation. For details on how Goulds Model 3171's can help *you* move uncooperative solids, write for Bulletin 726.2.



### Nuclear nomad of the seven seas

N. S. Savannah, first atomic-powered merchantman, will call at the seaports of the world as a symbol of the peaceful use of nuclear power. The 21,800-ton ship has a practically foolproof power plant. Its pressurized-water nuclear reactor uses uranium oxide fuel. Goulds Model 3655 (close-coupled centrifugal) pumps the radioactive waste water on both bilge and ballast service. The Model 3655 is available in 23 sizes with capacities to 2000 gpm, heads to 400 ft. Pump and motor are a single, compact unit, easy to install and ready to run. Standardization of parts holds down inventories. For full details, including specifications, construction information and performance charts, write for Bulletin 710.1.



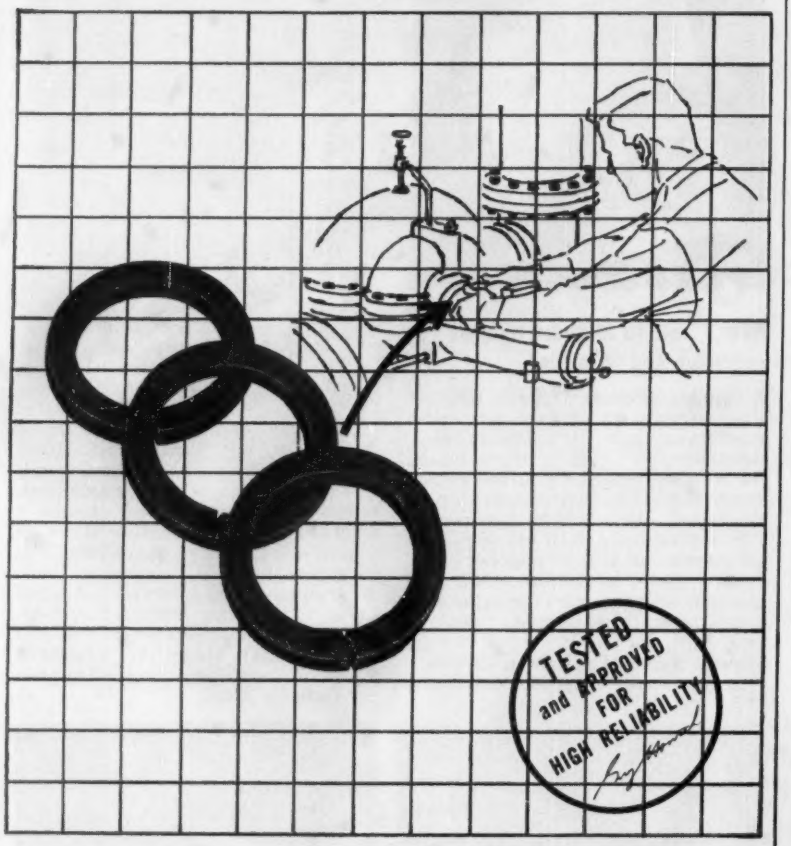

### NEW "king-size" vertical... capacities to 3180 gpm

Here are all the details on Goulds newest heavy-duty centrifugal sump and process pump—the "L" size Model 3171. Unit available in 316 stainless and other special alloys. Specifications, sectional views, construction materials, performance curves, dimensions—all are clearly given in Bulletin 726.2. For your copy, write Goulds Pumps, Inc., Dept. CE-110, Seneca Falls, N. Y.

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**R/M's Universal Plastic Packings** are so precision-engineered to pump shaft and valve stem requirements they put maintenance in the preventive class for you. Lubricants, ground in during manufacture, are so securely locked within the compound that even after wear sets in, the effectiveness of the bearing surface continues.

These packings, which keep machines operating at peak performance and with minimum downtime, are an example of how R/M's capability in the packing field meets all the expanding needs of industry.

R/M Universal Plastic Packings come in five different types. They are designed for use on steam rods, valve-stems, centrifugal pump shafts; in equipment handling gasoline, fuel oil and petroleum products; in equipment handling food and beverages. Let R/M's specialized engineering service solve your packing problems—let us know what your particular requirements are.

**R/M PACKINGS**
RAYBESTOS-MANHATTAN, INC.
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MECHANICAL PACKINGS AND GASKET MATERIALS


## Letters: Pro & Con

### Instrument Costs Defined

*Sir:*

Our interest in process instrumentation has become greater with the trend towards automation. But automation makes it more difficult to draw the line between instruments and other items of process plant cost, especially as regards remotely operated valves. If the latter are counted as instruments, corresponding amounts of cost are deducted from the equipment of piping categories. If, on the other hand, they are counted with piping, they add bigger sums than the previously used, hand-operated valves.

In using the data published in your magazine by N. G. Bach ("More Accurate Plant Cost Estimates," Sept. 22, 1958, pp. 155-159), we would like to know just what is included in the category of "instruments."

H. BACHMANN

Ciba Ltd.
Basle, Switzerland

*Sir:*

The "instruments" referred to in my article are defined in our standard code of construction accounts as follows:

"Instruments include measuring and controlling instruments, together with subassemblies and auxiliaries, such as pressure gages, industrial and laboratory thermometers, tachometers, stopwatches and panelboards. Also included are freight, delivery charges, taxes on sales and customs duties."

Installation or erection, piping and wiring to and from the instruments is not included as a part of the instrument cost. Piping work and materials for instruments, such as the placing of control valves, is performed by the pipefitter labor craft and is therefore classified as piping. Likewise, electrical work and materials, such as thermocouple wiring, is performed by the electrician labor craft and is therefore classified as electrical work.

In other words, the purchase of pneumatically and electrically op-

erated valves is charged to instruments. Installation of these valves is charged to piping.

Approximately one-third of all instrument charges is for valves.

N. G. BACH
Monsanto Chemical Co.
Texas City, Tex.

---

**Pro: Pro & Con**

*Sir:*

Your recent Pro & Con discussions are as good as the original articles. Let's have more controversies.

H. E. SCHWEYER
University of Florida
Gainesville, Fla.

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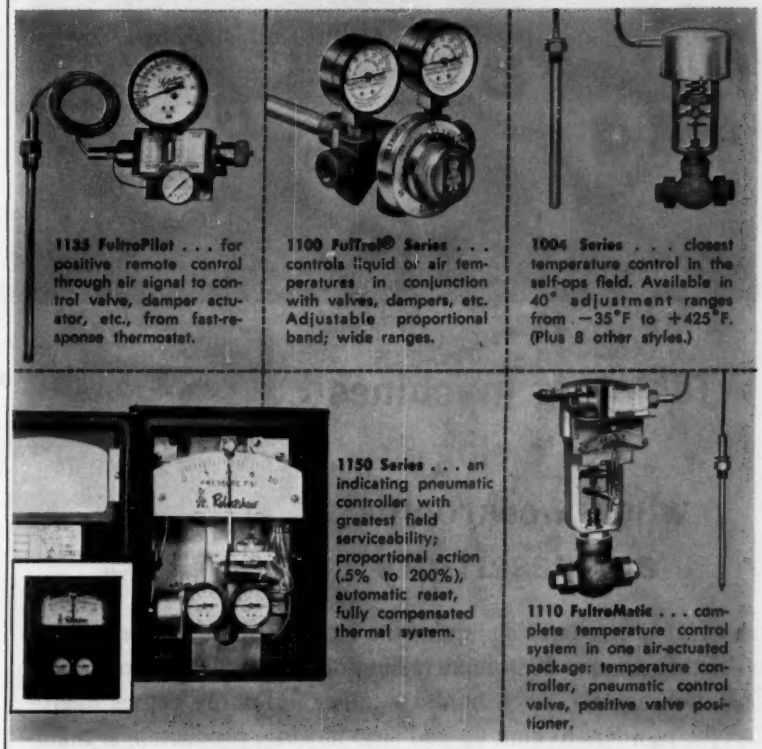
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From the rugged simplicity of self-ops to the more complicated requirements of an indicating controller, Robertshaw answers your temperature control needs — efficiently and economically.

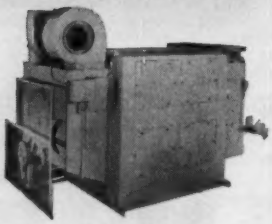
And whichever Robertshaw instrument best fits your particular job, you know there's quality all the way . . . quality of design, construction, performance.

Check the Robertshaw temperature and pressure controls for *your* needs. You'll find them shown in detail in Catalog A-VW. **Fulton Sylphon Division, Robertshaw-Fulton Controls Co., Knoxville 1, Tenn.**

Robertshaw® MR. CONTROLS



## Tableting machines don't clog when workrooms are desert-dry

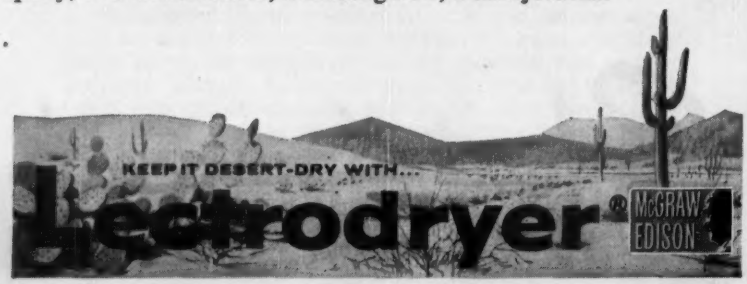


New Type CH Lectrodryer

A CHO Lectrodryer maintains the 15,680 cubic foot area of this tableting room at 20% relative humidity, regardless of conditions out-of-doors. So, when humid weather ordinarily causes hygroscopic powders to gum up and stop flowing, production is maintained here at full speed.

Have you, in the past, considered controlled dryness and found it too costly? It may pay to reopen those files and ask Pittsburgh Lectrodryer for drying recommendations. Dehumidification methods and efficiencies of dryers have been developed so much recently that the cost picture may be completely changed.

**DATA SHEETS ARE AVAILABLE** which describe typical humidity control installations. They'll serve as guides in planning your own systems. For copies and for other drying help, write Pittsburgh Lectrodryer Division, McGraw-Edison Company, 303 32nd Street, Pittsburgh 30, Pennsylvania.






statements by auditing any and all necessary records.

Many aspects of circulation can be determined through use of these reports—quantity and types of subscribers, how subscriptions are sold, percent who renew their subscriptions, etc.—thereby providing a qualitative as well as quantitative identification of the audience of the publication. (You helped provide this information on your application for a subscription when you filled in the name of your company, its size and products, and your job title.)

The ABC reports help take the guesswork out of planning a sound publication program based on the interests of the reader. They show any changes in the composition of the audience from year to year—providing a guide for possible editorial changes. For example, we know exactly how many of you have management responsibilities, how many of you work for engineering contractors, how many of you teach college, etc.

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Circulation Manager
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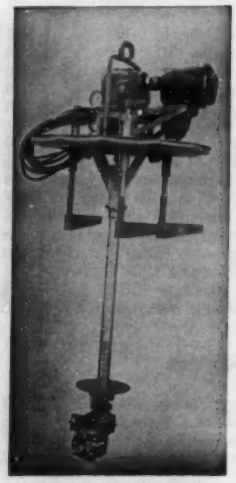
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**Germanium**.....Bulletin HP-102 describes various grades of semiconductor germanium and offers specifications including ingot size, packaging, resistivity.
**299B** High Purity Metals, Inc.

**Greases, Oils & Lubricants**.....There are more than 500 of these specialized greases, oils and lubricants available. Helpful information is offered.
**237** *Sinclair Refining Co.

* From advertisement, this issue.

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# BUFLOVAK EVAPORATORS



## for all chemicals...

acids, salts, pharmaceuticals, recovery of industrial waste...

Whatever your material in process may be, Buflovak Equipment will provide the way to the most profitable operation. The right evaporator, selected from a complete range of designs, can be job-tailored for your product. ■ The Buflovak evaporator line includes: Natural and Forced Circulation, Downflow, Agitated Film Roto-Vak, Crystallizers, Calandrias, Single and Multiple Effects. ■ For details, write for Catalog 372, Buflovak Equipment Division, 1551 Fillmore Avenue, Buffalo 11, New York.

*Buflovak Equipment Division*

**BLAW-KNOX**

# PRODUCTION COSTS DECREASE...

**WHEN THE BEST MIXER IS USED FOR EACH APPLICATION**

There is only one Mixer that is the most efficient for each different mixing requirement — let us recommend the best Mixer for your use based on our wide variety of types and almost a century of experience.



- 1 Pint — 5000 gallon sizes.
- Standard designs, or with any modifications required.
- Also Three Roller Mills, Dry Grinding Mills, and other types of Mixing, Grinding and Dispersing Equipment.

**CHAS. ROSS & SON CO., INC.**

Leading mfgrs. of wet or dry grinding Mills, Kneaders and Mixers of all types — since 1869.

150 Classon Ave., Brooklyn 5, N. Y.


LITERATURE . . .

**High-Strength Bronzes**.....Specifications of nine special wear and corrosion resistant alloys described in 20 page bulletin that includes chemical compositions.
300A Ampco Metal, Inc.

**Latex**.....Properties of vinyl-pyrrolidone/vinyl acetate copolymer used in adhesives, coating, hairsprays etc. are described in 20 page brochure.
300B Antara Chemicals

**Lubricants**.....Oil life extended, lubrication costs slashed, maintenance techniques improved, equipment downtime reduced. Information available on request.
6-7 *Mobil Oil Co.

**Methanol**....The new Methanol Guidebook contains 32-pages of useful tables, graphs & charts . . . Information sections include specifications, chemical properties, etc.
139 *Commercial Solvents Corp.

**Paraffins**.....Brochure "Parolls for the Lubricant Industry" gives complete listing of all available chlorinated paraffins from liquid to resin grades.
300C Dover Chemical Corp.

**Plastic Firebrick**.....Bulletin gives advantages, characteristics, recommendations and installation instructions of brick used for lining and repair of incinerators.
300D J. H. France Refractories Co.

**Propylene Glycol**.....is an excellent solvent for dyes, essential oils, resins, vitamins A & B, & many other organic chemicals. Copy of "Propylene Glycol & Cosmetics".
241c *Union Carbide Chem. Co.

**Refrigerant**.....$CO_2$ is handled and stored in a variety of forms & quantities ranging from "Low-Pressure" units to 24 & 30 ton tank cars, as well as dry ice.
302 *Olin Mathieson

**Resin**.....Amberlite 200 is a high capacity, strongly acidic cation exchange resin. Offers high resistance to oxidation. Information & samples offered.
117 *Rohm & Haas Co.

**Rubber Lubricant**.....Ucon Rubber Lubricant 77 is available at competitive prices & in commercial quantities. Technical information bulletin offered.
241b *Union Carbide Chem. Co.

**Silicones**.....Bulletin describes variety of uses of different silicone materials and ways they can be used to solve tricky operating and maintenance problems.
300E General Electric Co.

**Wood Deterioration**.....Causes, symptoms and suggested cures for wood deterioration in cooling towers contained in 8-page illustrated study No. 85.
300F Nalco Chemical Co.

## Construction Material

**Aluminized Steel**.....Type 1 resists heat and corrosion, gives parts high strength and rigidity, and has high heat reflectivity. Complete information.
88 *Armco Steel Corp.

* From advertisement, this issue.


# PROFIT MARGINS INCREASE...

**WHEN THE BEST MIXER IS USED FOR EACH APPLICATION**

There is only one Mixer that is the most efficient for each different mixing requirement — let us recommend the best Mixer for your use based on our wide variety of types and almost a century of experience.



- 1 Pint — 5000 gallon sizes.
- Standard designs, or with any modifications required.
- Also Three Roller Mills, Dry Grinding Mills, and other types of Mixing, Grinding and Dispersing Equipment.

**CHAS. ROSS & SON CO., INC**

Leading mfgrs. of wet or dry grinding Mills, Kneaders and Mixers of all types — since 1869.

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Maintaining a constant temperature of 70 to 72° F in a 16⅔% sulfuric acid solution is an ideal application for Platecoil... typical of many engineered by Tranter Manufacturing inc., Lansing, Michigan.

Corrosive environments dictate the use of stainless steel, Tranter's rigid production requirements dictate the use of J&L Consistent Quality stainless steel.

Why J&L? Here's the reason given by Mr. M. C. Nolen, Tranter Purchasing Agent:

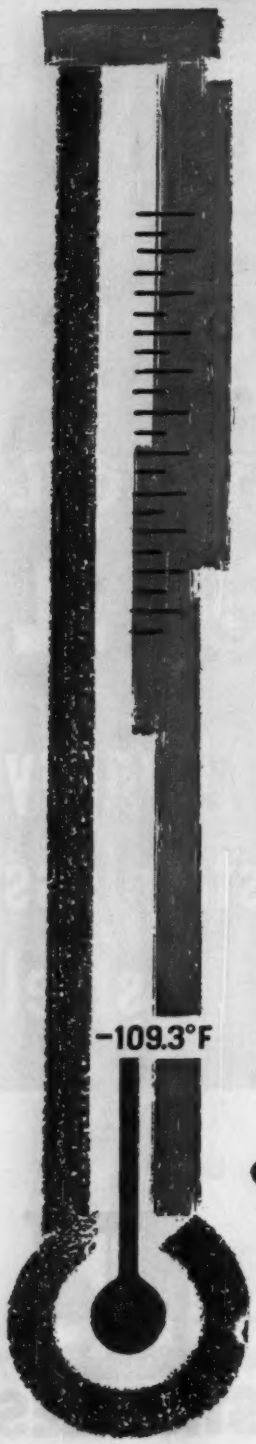
> "Tranter uses J&L stainless because of its uniform quality. It takes all the headaches out of raw materials and makes our job a matter of just processing this superior product."

*Plants and Service Centers:*
*Los Angeles • Kenilworth (N. J.) • Youngstown • Louisville (Ohio) • Indianapolis • Detroit*

J&L STAINLESS
SHEET • STRIP • BAR • WIRE

**Jones & Laughlin Steel Corporation** • STAINLESS and STRIP DIVISION • DETROIT 34

# $CO_2$ for refrigeration




**Available Refrigeration Potential**

**As Dry Ice** **Approx. 275 BTU/lb.**
**As Liquid @ 0°F.** **Approx. 130 BTU/lb.**

Wherever refrigeration is needed, $CO_2$ does the job rapidly, economically and well. Here's the refrigerant that cools everything...without expensive equipment and with quick, clean efficiency. Here are just a few of the places where fast-acting $CO_2$ can save you money.

| | |
|---|---|
| Chill grinding | Freezing tissue |
| Freeze drying | Investment casting |
| Drill cooling | Alloy treatment |
| Aluminum anodizing | Dewaxing oils |
| Alloy treatment | Rubber tumbling |
| Mixing | Hardening |

Olin Mathieson $CO_2$ is handled and stored in a variety of forms and quantities ranging from "Low-Pressure" units to 24- and 30-ton tank cars for direct unloading to your process, as well as dry ice. Why not contact an Olin Mathieson representative soon for an informative discussion that may open new and more economical uses for this safe, tested refrigerant.

7334

**Olin Mathieson**
CHEMICALS DIVISION, BALTIMORE 3, MD.

CHEMICALS


LITERATURE . . .

**Aluminum Process Pipe**.....is available in schedules 5, 10, 40 and 80. In both Duplex & Heavy-End types. Data file on Aluminum for Chemical Process Applications is offered.
8-9 *Reynolds Metals Co.

**Cable**.....Safety MI Cable for hazardous applications and for remote control & instrumentation. Catalog outlines characteristics of this cable.
313 *General Cable Corp.

**Cable**.....All the facts and figures about the versatile new CT cable including what sizes are available "off the shelf" are summed up in a 4-page booklet.
255 *Rome Cable Div. of Alcoa

**Casting Alloy**......"HOM" is a special high nickel alloy developed to produce castings that meet high temperature requirements. Additional information.
304 *The Duraloy Co.

**Ceramic Type Castings**.....with thin-wall designs which do not require expensive machining; no fear of voids with light & heavy adjacent sections. Information.
91 *Waukesha Foundry Co.

**Coating**.....Carbo Zinc 11 is a zinc-filled inorganic protective coating. Water insoluble 20 minutes after applying. Information, technical data, uses & samples.
270 *Carboline Co.

**Coating**.....Glaco, insures outstanding chemical resistance to both inorganic & organic agents. A 12-page full color brochure on custom-engineered coating.
L320 *National Glaco Chemical Corp.

**Coating Systems**.....Corrosion Data File includes a survey of corrosion problems in the Chemical Industry, data on Systems & a coating selector guide.
22-23 *Pittsburgh Coke & Chem. Co.

**Compression-Gauge Gaskets**.....The gold Flexite Finish for metal gauge rings in these gaskets is new. Highly corrosion resistant. Sample sent on request.
259 *Flexitallic Gasket Co.

**Corrosion-Resistance**.....Installations such as tanks, industrial floors, rigid plastic structures can be designed & fabricated. Information in Bul. CC-3.
L311 *Atlas Mineral Products Co.

**Fabricating**.....Plate shop can handle custom work of all kinds & sizes. Includes complete inspection facilities. Booklet on plate fabricating facilities & services.
34-35 *Amer. Bridge Div., U. S. Steel

**Gasket Material**.....Booklet describes "Armalon" felts & includes data on characteristics, detailed list of specific applications, & information on sizes & thicknesses.
95 *E. I. Du Pont

**Gaskets**.....Chempac gaskets are soft, conformable and effect a seal at low bolting. Available in pipe sizes from ½" to 12" as standard. Information available.
98 *Johns-Manville

**Gaskets, Teflon-jacketed**.....in slit envelope, milled envelope, formed shield & double jacket designs & in a wide selection of filler materials & thicknesses. Cat. AD-154.
20-21a *Garlock Inc.

* From advertisement, this issue.

NO LUBRICATION
NO CONTAMINATION
NO MAINTENANCE

# SULZER

## NON-LUBRICATED RINGLESS PISTON COMPRESSOR

**Assures Absolute Contamination-Free Compression Of Dry Or Moist Gases!**



- Unique Ringless Piston And Frictionless Piston Rod Stuffing-Box Requires Little Or No Maintenance
- For Air, Oxygen, Hydrogen, Dry Chlorine And Other Industrial Gases
- Available For Capacities Up To 4000 cfm And Discharge Pressures Up To 850 psig
- Over 25 Years Of Manufacturing Experience In Ringless, Non-Lubricated Piston Compressors

*For further information, specifications, etc., contact:*

**SULZER**

SULZER BROS. INC.
50 Church Street, New York 7, N. Y.






# DUO-DOOR STERILIZER!

**New, built-in dry heat sterilizer recesses between sterile and non-sterile areas.**

Now, a completely modern designed sterilizer for your needs from HOTPACK. Two-door, interlocked, mechanically convected sterilizer prevents contamination of sterile area and product . . . load in non-sterile side — remove safe product in sterile area! . . . Adjustable air exhaust and controls are located on non-sterile side, and air intake on sterile side.

. . . Instant, uniform temperatures, ambient to 500°F ± 1°F, are assured by Dry Heat transfer system, and controlled by accurate indicating-controlling thermostat.

. . . Equipped with preset timer device for sterilizer cycling.

. . . HOTPACK'S safety control Limitstat prevents damage from excessive temperature.

. . . Cabinets are constructed of heavy gauge steel, treated for rust prevention. *Chambers are easy-to-clean polished stainless steel.*

. . . Available in 8 to 31 cu. ft. capacities or to your specifications.

*For new sterilizer bulletin write to:*

Hotpack SINCE 1908

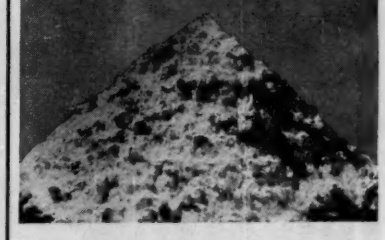
BATH
OVENS WALK-IN-OVEN

**THE ELECTRIC HOTPACK CO., INC.**
5078 COTTMAN AVENUE • PHILA. 35, PA.



# Hercules ASBESTOS

## IMPROVES FILTRATION CUTS MATERIAL COSTS



Hercules Asbestos will improve your filtrate and reduce your material costs because:

1. It gives higher clarity.
2. Precoat layers tend to form a matrix on the filter leaves which is firm and will not collapse or sag, if flow is stopped.
3. It readily forms on open mesh screens without clogging, and open mesh screening is easier to clean than close mesh.
4. It forms a precoat layer quickly with very little recirculation time.
5. Precoats not only retain diatomaceous earth but also prevent break-through over a complete cycle.
6. It jet cleans readily and easily.
7. It functions in any type pressure leaf filter.

Mail coupon for sample and technical bulletin.

**HERCULES FILTER CORP.**
208 ETHYL AVENUE
HAWTHORNE, NEW JERSEY

SEND COUPON TODAY

HERCULES FILTER CORP.
208 Ethyl Avenue
Hawthorne, New Jersey
Send me technical bulletin and free sample.

NAME _____
COMPANY _____
ADDRESS _____
CITY _____ STATE _____
PRODUCT TO BE FILTERED _____

# HOW TO BEAT THE HEAT

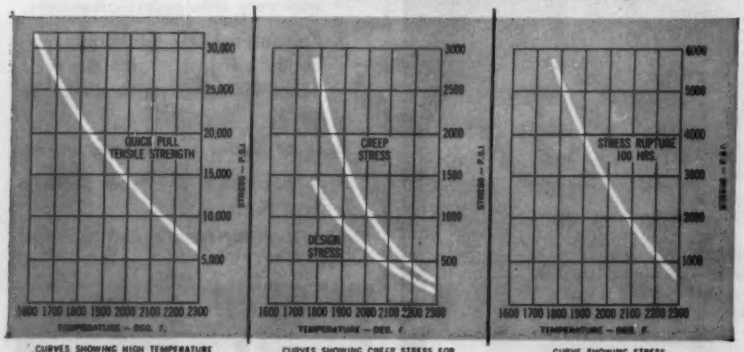
*for strong high alloy requirements in the 1,800° to 2,300° F range!*

DURALOY HOM*

*Covered by U.S. Patents

## *casting alloy*

Duraloy "HOM" is a special high nickel alloy developed to produce castings that meet high temperature requirements, especially when castings are subject to oxidizing atmospheres.




CURVES SHOWING HIGH TEMPERATURE SHORT-TIME TENSILE STRENGTH OF DURALOY-HOM

CURVES SHOWING CREEP STRESS FOR CREEP RATE OF 1% IN 10,000 HOURS AND RECOMMENDED DESIGN STRESS FOR DURALOY-HOM

CURVE SHOWING STRESS TO RUPTURE AT 100 HOURS FOR DURALOY-HOM

Castings of DURALOY "HOM" are now being produced by our three methods: static, centrifugal and shell molded. Write today for additional information on this versatile new alloy.

THE DURALOY Company
OFFICE AND PLANT: Scottdale, Pa.
EASTERN OFFICE: 12 East 41st Street, New York 17, N. Y.
CHICAGO OFFICE: 332 South Michigan Avenue
DETROIT OFFICE: 23906 Woodward Avenue, Pleasant Ridge, Mich.


## LITERATURE . . .

**Insulation**.....Styrofoam insulation is an effective moisture and vapor barrier, moisture does not penetrate through the insulation. Complete information on request.
**257** *The Dow Chemical Co.

**Insulation**.....The new Industrial Insulation Catalog is offered. Also Data Sheets on the complete line of accessories for use with Foamglas insulation.
**171** *Pittsburgh Corning Corp.

**Insulation Materials**.....Leaflet lists plastic and ceramic insulating materials and includes temperature limits for 88 materials plus thermal expansion coefficients.
**304A** Mycalex Corp. of America

**Lead Products**.....These products include chemical lead sheets to your requirements; pipe, bends, traps & standard fittings. Bul. 162, the Lead Handbook for the CPI.
**275** *American Smelting & Refining

**Packings**.....Chempro Styles No. 300 & 305 are being used in a wide range of static & semi-static packing applications where rotation is not a factor. Rev. Bul. CP-552.
**133** *Chemicals & Power Products

**Packings**.....Lattice-Braid teflon packings are strong, long-lasting, chemically inert. Withstand temperatures ranging from —120 F to +500 F. Catalog AD-131.
**20-21c** *Garlock Inc.

**Platinum Metals**.....in all shapes and forms . . . sheet, strip, foil, wire, tubing, gauze, salts and chemicals. Clads & composities also available in many forms. Bulletin P-6.
**173** *J. Bishop & Co.

**Refractories**.....The line has been enlarged by the addition of new heavy duty firebrick & new ramming mixes. Complete Properties Sheets & additional information.
**137** . . . *The Babcock & Wilcox Co.

**Refractories, Special**.....offer corrosion resistance & withstand temperatures of from 2800F to 3000F. Carry heavy imposed loads & are unaffected by abrasion. Booklet.
**305** *Carborundum

**Rubber Linings**.....for tanks, pipe & process equipment. Permanent protection against corrosion & contamination. Permanent rubber-to-metal bond. Cat. No. 7115.
**70** *Raybestos-Manhattan, Inc.

**Stainless Steel**.....New booklet "Producing Stainless Steels" is fully illustrated. It includes detailed sections on stainless steel plates, heads, forgings, etc.
**R262** *G. O. Carlson, Inc.

**Stainless Steel**.....plate and plate products in a wide range of superior analyses in any thickness. Details on these grades and inventory information on all types.
**263** *G. O. Carlson Inc.

**Tank Linings**.....A full line of tank lining materials including Tygon, Kel-F, Penton, Resilon, and Acikote. Materials that exactly fit your needs. Complete information.
**100** *U. S. Stoneware

**Thermocouple Extension Wire & Cable**.....in a wide variety of size, insulation, types & calibration for your application, with prompt delivery on all standard materials. Bul.
**310** *Thermo Electric Co., Inc.

* From advertisement, this issue.

**CARBORUNDUM'S** TECHNICAL INFORMATION ON UNUSUAL REFRACTORIES **Data sheet**

*Choosing materials for*

# CORROSION RESISTANCE

Though seldom associated with resistance to corrosion, certain refractories made by Carborundum outlast and outperform other materials of construction—as the table below indicates.

These special refractories withstand many gases, acids, salts and molten metals. They can be used as small, specialized parts or as complete hearths, walls, and roofs of large furnaces and other processing equipment, (see pictures at right).

In addition to essential corrosion resistance, these unique refractories withstand temperatures of from 2800°F to over 3000°F, carry heavy imposed loads, and are virtually unaffected by abrasion.

The tables below offer a very rough guide to properties and applications. Feel free to call on Carborundum for more comprehensive data that can be used in solving your particular problem.



Arch, jambs and sidewalls of CARBOFRAX® silicon carbide in this aluminum reverberatory furnace have resisted attack by corrosive molten aluminum for more than two years.



These parts of REFRAX® nitride-bonded silicon carbide, a Carborundum refractory, have exceptional resistance to corrosion. They are made in complex and accurately dimensioned shapes. Adapted to many installations, REFRAX shapes frequently outlast expensive alloys.

## TYPICAL APPLICATIONS INVOLVING SEVERE CORROSION

- Generators handling superheated steam, oxygen and pulverized coal
- Aluminum reduction cells
- Rock wool furnaces
- Wire guides and blocks in pickling tanks
- Mannheim furnaces
- Hydrogen chloride burners
- Multiple hearth roasters, also rabble blades and teeth
- Artificial gas generators
- Spray nozzles
- Aluminum furnaces and pumps for molten aluminum
- Sinker rolls for aluminizing
- Acid slurry pumps
- Incinerators
- Slag bottomed boilers

## CHEMICAL RESISTANCE OF TYPICAL CARBORUNDUM REFRACTORIES

G = Good F = Fair NR = Not recommended

| | Silicon carbide | Aluminum oxide |
|---|---|---|
| **MOLTEN METALS** | | |
| AL | G | G |
| Sb | F | G |
| Cu | G | G |
| Fe | NR | G |
| Mg | F | G |
| Ni | NR | G |
| **ACIDS (Heated)** | | |
| $HHO_3$ | G | G |
| $H_2SO_4$ | G | G |
| **ACIDS (Heated)—Contd.** | | |
| $H_3PO_4$ | F | G |
| HCl | G | G |
| **GASES** | | |
| $CO_2$ | G | G |
| $H_2O$ | G | G |
| $O_2$ | G | G |
| $H_2$ | G | G |
| $Cl_2$ | NR | F |
| $SO_2$ | G | G |
| $S_2$ | F | G |



*Write today for your free copy of "Super Refractories by Carborundum." The address: H-110 Refractories Division, Perth Amboy, N. J.*

*For engineered refractories, count on* **CARBORUNDUM®**

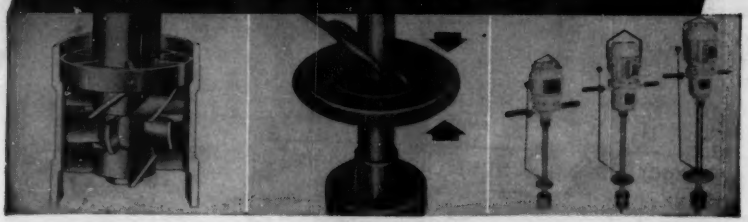
# SHEAR-FLOW



Shear-Flow's high shear action produces finer, faster blending, dispersing and homogenizing. The new Model RL Shear-Flow portable mixer represents a major advance in mixer design. The new Hi-Shear Head consists of two rotating impellers and two stationary stators enclosed in a cylindrical housing. The fine clearance between impellers and stators results in rapid shearing action and a high degree of turbulence, resulting in a more complete reduction of agglomerates within the mixture.

- Greatly reduces mixing time
- Uniform circulation—no vortex
- Emulsifies immiscible liquids
- Controllable flow pattern
- Chemically inert seals
- Handles viscous materials with ease
- No operating torque

## HAS A GOOD HEAD FOR BUSINESS



Close tolerances between impellers and stators promotes high shear for reduction and dispersion of material.

Adjustable deflector plate controls flow pattern for desired mixing action and air entrainment.

Three basic portable models for processing 1 to 250 gals. plus continuous mix units for high volume processing.

*Write today for complete information on the Shear-Flow line of mixers.*

**SHEAR-FLOW**
GABB SPECIAL PRODUCTS INC.

**GABB SPECIAL PRODUCTS INC.**
Windsor Locks, Conn.


LITERATURE . . .

**Vacuum Melting Techniques**.....Information on modern melting techniques & the advantages of Consutrode, Invac, & Invacutrode alloys. New booklet offered.
161 *Allegheny Ludlum Steel Corp.

**Wire Cloth Fabrications**.....Wire cloth manufactured from any metal or alloy, including titanium, in nine basic weaves. The 94-Page Catalog is offered.
153 *The Cambridge Wire Cloth Co.

## Electrical & Mechanical

**Expansion Joints**.....Catalog AD-137 contains information on solid teflon and teflon-lined expansion joints for chemical processing applications.
20-21b *Garlock Inc.

**Mechanical Seals**.....Chemiseal mechanical seals are available in standard sizes to fit all pump shafts ⅞" to 2¼" shaft. Details in Catalog AD-164.
20-21d *Garlock Inc.

**Motoreducers**.....All-Steel Motoreducers with horsepower range: to 75 hp. . . . standard output speeds: 780 rpm (high) to 1.2 rpm (low) are covered in Bulletin 3100.
79 *The Falk Corp.

**Motor Starters**.....Solenoid starters with reliable & permanently accurate overload relays protect against motor burnouts, regardless of time or atmospheric conditions. Bul.
69 *Allen-Bradley

**Motors**.....Type EP, standard protected against damage from dust, abrasives, fumes, steel chips or filings; Type JP, explosion-proof for use in hazardous locations. Bul.
60 Wagner Electric Corp.

**Rupture Discs**.....provide an unrestricted relief opening. Available in sizes ranging from ⅛" to 44" in diameter, covering rupture pressures from 3 to 100,000 PSI.
277 *Black, Sivalls & Bryson

**Turbines**.....with a totally enclosed governor . . . totally enclosed, independently operated safety trip . . . easily replaceable packing & bearings, etc. Further facts Cat. 200.
65 *Coppus Engineering Corp.

**Volt Starter**.....Complete details on the EC & M 2200-4800 vo't starters contained in Bulletin 8210. They feature fully automatic synchronization.
81 *Square D Company

## Handling & Packaging

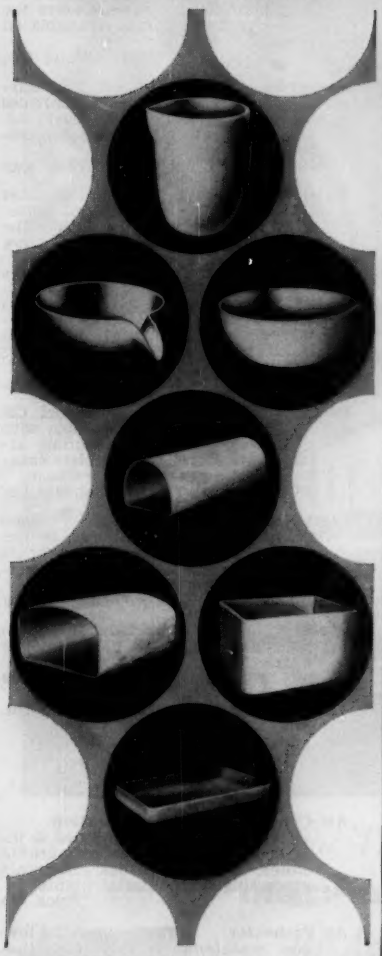
**Air Vibrators**.....Easy to install, units will operate in hazardous atmospheres, inclement weather or magnetic dusts. Application catalog offered.
TL323 *National Air Vibrator Co.

**Automatic Scales**.....Technical bulletin on how automatic bagging and proportioning scales are promoting good housekeeping, controlling quality, etc.
336 *Richardson Scale Co.

* From advertisement, this issue.

# VITREOSIL®

## PURE FUSED QUARTZ



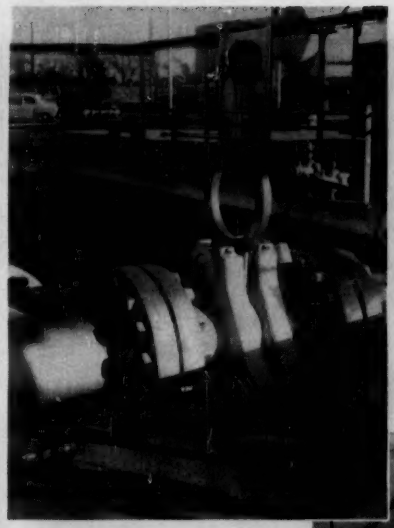
### FINEST QUALITY IN INDUSTRIAL WARE

- Absolute Chemical Purity
- Extreme Heat Resistance
- Thermal Shock Resistance
- Chemical Inertness
- Outstanding Electrical Properties
- Full Range Radiant Energy Transmission

VITREOSIL easily meets critical production requirements . . . replaces more costly materials. Available in many types and sizes. Also fabricated to your special needs. See our ad in **Chemical Engineering Catalog.**

***Write for complete, illustrated catalog.***

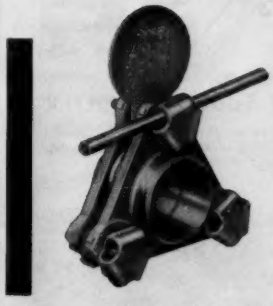
THERMAL AMERICAN FUSED QUARTZ CO., INC.
18-20 Salem St. Dover, N. J.



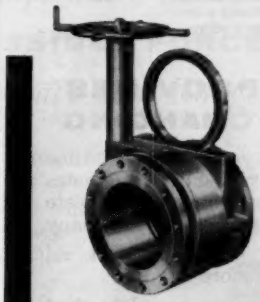
# FAST, EASY, POSITIVE LINE BLINDING

## Hamer Line Blind Valves





The famous 3-Bolt Hamer Line Blind Valve has set the standard for positive, dependable, economical line blinding in all industries.



Handwheel operated Hamer Rigid Type Line Blind Valves are ideal for installation where conditions prevent spreading the line to reverse the spectacle plate.

**FAST** . . . because one man can reverse the spectacle plate from open to closed position in a matter of minutes.

**EASY** . . . because bar or handwheel operation provides tremendous leverage for spreading and tightening the hubs that hold the spectacle plate. Wedges, hammers, wrenches needed for spreading conventional flanges are eliminated.

**POSITIVE** . . . because nothing seals as securely and permanently as the solid spectacle plate clamped between the hubs of a Hamer Line Blind Valve.

Ask your nearest Hamer Line Blind Valve specialist about the multiple advantages of installing them wherever positive line shut-off is essential. Write for new Hamer Valve Catalog 60.

WECO

WELL EQUIPMENT MFG. CORP.
HOUSTON, TEXAS

Division of CHIKSAN COMPANY *a subsidiary of* FOOD MACHINERY AND CHEMICAL CORPORATION

HV-2-60

fmc



WECO UNIONS



CHIKSAN SWIVEL JOINTS



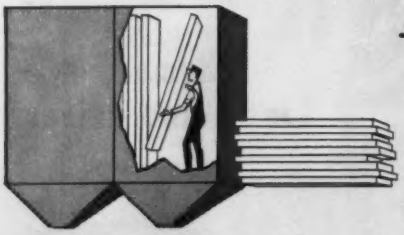
HAMER LINE BLIND VALVES



HAMER PLUG VALVES

SINCE 1870 SLY

# SLY DUST FILTERS For ACCESSIBILITY

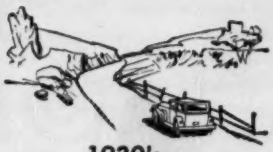




1900's
SLY DUST ARRESTER

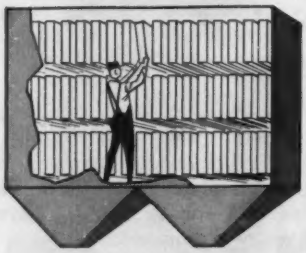
Every cloth screen from the end of the arrester had to be removed to reach the faulty screen.





1930's
SLY TUBE-TYPE FILTER

To replace a tube required at least partial disassembly of every other tube in the way.





TODAY
NEW SLY
"ROLL-CLEAN"
DYNACLONE®

Any filter bag is easily accessible and can be replaced without need for removing others.

## NEW SLY DYNACLONE PROVIDES FASTEST, EASIEST BAG CHANGING

*Whether you change one bag, or the entire filter,* you do it in less time with the Dynaclone. Quick replacement of individual bags eliminates the need for costly rebagging should only a few be worn. Complete change is also fastest . . . the Dynaclone has only one half as many bags as other filters with the same cloth area. In addition . . .

*New "Resist-O-Wear" bags offer* 200 to 300% more bag life.

*The Dynaclone operates continuously.* It provides complete dust suppression through constant suction.

*The Dynaclone is automatically self-cleaning by reverse air.* A single exhaust fan provides *both* suction for dust collection and air for bag cleaning. No auxiliary blowers required.

*And the Dynaclone provides 20 to 40% more cloth* in a given space than other makes of dust filters.

The Dynaclone has been proved in more than 1,000 installations. Investigate its advantages on your applications . . .

*SEND FOR 36-PAGE CATALOG 104*

**THE W. W. SLY MANUFACTURING CO.**

4771 Train Avenue • Cleveland 1, Ohio • Offices in Principal Cities • Overseas Licensee: Andrew Air Conditioning Ltd., London S. W. 1, England

LITERATURE . . .

**Bulk Handling System**.....A new 32-page report has the answers to your bulk handling problems. Covers the Tote System in detail. Available on request.
62 *Tote System, Inc.

**Conveyors, Air-Gravity**.....The Air-Float air-gravity conveyor provides the answers to dry solids conveying. Complete information in Bulletin 58-K.
146 *Kennedy Van Saun

**Materials Handling**.....The Dempster Dinosaur offers a variety of materials handling applications. The new Dinosaur brochure is now available.
94 *Dempster Brothers

**Materials Handling**.....Complete information on "Payloaders" is contained in "Industrial Materials Handling the Payloader way". Available on request.
75 *The Frank G. Hough Co.

**Portable Bag Closer**.....Model CR weighs only 9½ lbs. Available with or without Faseal tape binding attachment. Details & complete catalog file of equipment on request.
TL339 *Dave Fischbein Co.

**Screw Conveyor**.....Data book covers the complete screw conveyor service including a full line of components & a full line of troughs, ball & babbitted bearing hangers, etc.
102 *Link-Belt Co.

**Stacker**.....6-page circular describes high-stacking, 2,000 lb. capacity walkie with a built-in charger that recharges overnight on any 115 volt AC outlet.
308A Lewis-Shepard Products Inc.

## Heating & Cooling

**Air Conditioning & Refrigeration**..... systems of all types, designed & installed for hotels, restaurants, stores, office buildings, hospitals, processing & industrial plants.
285 *Frick Co.

**Air Preheater**.....Facts about the low-cost maintenance, easy inspection, in service cleanability, space saving compactness of the Air Preheater in a new brochure.
157 *The Air Preheater Corp.

**Cal-Cord**.....is a new, flexible cord developed especially for high temperature laboratory heating applications. Delivers uniform temperatures. Information.
162 *Glas-Col

**Fired Air Heaters**.....Direct or indirect fired, they may be operated on oil or gas to produce temp. to 1900 F, flows to 500 lbs/sec, & pressures to 5000 psig. Buls.
318 *Thermal Research & Engineering

**Furnace**.....Successful applications of the Skinner Furnace include: Oxidizing Roast, Reduction Roast, Chloridizing Roast, and Drying. Many other applications possible.
R321 *Mine & Smelter Supply Co.

**Heat Exchanger Tubing**....Lectrosonic is a welded tube with a new concept of quality, designed specifically for economical long life in heat exchangers. Bul. T-431.
178 *The Babcock & Wilcox Co.

* From advertisement, this issue.



## *The Temperature Control Powered by the*

## IRREPRESSIBLE FORCE OF MERCURY—

## *for Accuracy with Rugged Dependability*



All Partlow temperature controls are directly and positively actuated by mercury, the metal in liquid form whose reaction to changes in temperature is as predictable as it is powerful.

Unlike delicate electronic controllers, the mercury-actuated Partlow requires no outside power source. No amplifiers. No finicky levers. And no "babying"! With a Partlow you can be sure of getting accurate, dependable control even under extreme conditions of shock and vibration.

Mercury-actuation makes possible maximum design efficiency and simplicity too. The Partlow has fewer parts to go wrong. And fewer service problems (with less "down" time) should trouble occur. You can replace the thermal element of any Partlow control instantly, right at the job site, without recalibrating, fitting or factory adjustment.

Whatever the process or application, you'll find a Partlow temperature control to fit it dependably, economically, *precisely*. Mail coupon today for full details.

**PARTLOW**
**TEMPERATURE CONTROLS**
World Export:
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THE PARTLOW CORP., Dept. E-1160
NEW HARTFORD, N. Y.
Please send condensed Catalog of Partlow temperature controls and allied equipment for industrial heating and refrigeration.

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Company.....
Address.....
City and State.....
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# Name Your Application!



## Do It Better With *Thermo Electric* *Thermocouple Extension Cables and Wires*

You can obtain Thermo Electric thermocouple extension wire and cable in the widest variety of size, insulation, type and calibration, for your application—with prompt delivery of all standard materials.

New on the stock list, is the time and labor saving "Thermo-Cable," from 6 to 56 matched pairs of I.S.A. color-coded thermocouple leads, individually insulated in PVC—collectively wrapped in "Mylar" aluminum-backed tape—with a tight-fitting PVC outer sheath. "Thermo-Cable" is practically impervious to moisture, abrasion, temperature, gasses and chemicals. Saves you the time, cost and effort of pulling individual wires through conduit.

Individual or duplex thermocouple and extension wires are available in all standard calibrations—many in gages from 14 to 40—insulated with Polyvinyl Chloride, cotton lacquer, Nylon, Teflon, Fiberglass, Asbestos or combinations of these materials. Metallic overbraids of stainless steel and other high-temperature materials provide extra mechanical protection and shielding.

"Ceramo", Thermo Electric's metal-sheathed ceramic insulated thermocouple wire is used for extra-high temperature and nuclear applications.

Thermo-Electric also supplies thermocouple wires to meet Mil-Spec requirements.

For information on selecting the right wire for your application,

***write today for Bulletin 32-WS-4***

**Thermo Electric** CO., INC.
SADDLE BROOK, NEW JERSEY

**In Canada: THERMO ELECTRIC (Canada) LTD., Brampton, Ont.**


LITERATURE . . .

**Heat Exchangers**.....A new four-color bulletin describes and illustrates the complete line of heat exchangers that fulfill nearly all normal requirements. Bul. 820.
L321 *Manning & Lewis Engr. Co.

**Heat Exchangers**.....Brazed Aluminum heat exchangers feature reduced refrigeration costs, close temp. approaches & trouble-free operation. Complete data.
10-11 *Trane Co.

**Heaters**.....Catalog 956 covers Grid Unit Heaters, Blast Heaters and Radiators. Designed for operation on steam pressure up to 250 PSI 450 degree temperature.
334 *D. J. Murray Mfg. Co.

**Heat Transfer**.....Platecoil is available in standard styles or specially formed and fabricated. Complete engineering data & assistance available. Bul. P61.
152 *Tranter Mfg. Inc. Platecoil Div.

**Heat Transfer Cement**.....Thermon can be applied over both steam tracing & electrical resistance systems & is effective for heating & cooling operations. Bul. 300.
L273 *Thermon Mfg. Co.

**Packaged Boilers**.....Sizes through 600 hp . . . oil, gas and combination oil-gas firing . . . larger sizes in Springfield water-tube boilers. Booklet "How to Select a Boiler."
37 *Cleaver-Brooks Co.

**Panelcoil**.....Complete technical data and pricing on Panelcoil can be found in Data Sheet 15-60 Series and in Price Bulletin 259 which is available on request.
TR324 *Dean Products, Inc.

**Rotary Kilns**.....with proven design & construction for processing a wide variety of materials-pre-heating and waste disposal are described in Bul. No. 118.
64 *The C. O. Bartlett & Snow Co.

**Rotary Kilns**.....have all welded steel shells, feed & discharge end seals, heat recuperating chain systems for wet process kilns, improved kiln feeders, etc. Bul. 1115.
30 *Traylor Engr. & Mfg. Co.

**Steam Traps**.....A 48-page book tells how to correctly size, install & maintain steam traps for any pressure, temperature or load. Additional data in Catalog K.
4 *Armstrong Machine Works

**Steam Traps**.....Thermostatic steam traps operate on a true balanced vapor-pressure principle, they discharge air, condensates & other non-condensables. Cat. 400.
286 *W. H. Nicholson & Co.

**Steam Traps, Impulse**.....Series 40 are designed specifically to gobble up extra heavy condensate loads. Also feature high-temp. discharge characteristics. Bul. T-1743.
167 *Yarnall-Waring Co.

## Instruments & Controls

**Comparators**.....Handbook, "Modern pH and Chlorine Control" contains 101 pages of tech. data & useful information. Gives theory & application of pH control.
R323 *W. A. Taylor & Co.

* From advertisement, this issue.

# Atlas

**INSTALLATIONS PROVIDE PERMANENT CORROSION PROTECTION!**

## tanks

Pickling, plating, chemical processing and storage tanks of all kinds, utilizing corrosion-proof linings and cements, are designed and constructed by Atlas to completely resist all types of corrosives.

## floors

Atlas industrial floors for chemical processing areas, pickling and plating rooms form a corrosion-proof base against attack by alkalies, acids, solvents and salts.

## hoods, ducts, fume systems

Rigid plastic structures, designed and fabricated by Atlas from polyvinyl chloride, exhaust all types of corrosive fumes. Plastic tanks and piping systems contain and convey corrosive solutions. All are completely corrosion-resistant throughout.

*These Atlas installations will permanently protect your client's plant from corrosion. Write for Bulletin CC-3.*

ATLAS MINERAL
MERTZTOWN, PENNSYLVANIA



LOW COST
light weight
**FORGED**
carbon steel

NOM. I. P. S.
1/2" thru 8"

# back-up flanges
# CAMCO

## FOR USE WITH SCHEDULE 5 and SCHEDULE 10 STAINLESS STEEL STUB ENDS and PIPE

Can be used with slip-on or lap joint stub ends where pressure and temperature problems are not encountered and Stainless is utilized to avoid contamination or corrosion.

Flange surfaces protected with a baked enamel finish.

THE Quality LINE IN FITTINGS
CAMCO
FITTINGS, INC.
301 STATE STREET
NORTH HAVEN, CONNECTICUT

For prices and dimensional data send for Schedule FCS-460



# ACCURATE CHEMICAL FEEDING

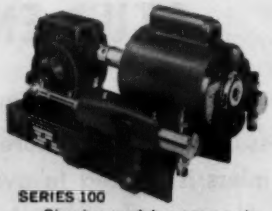
*from .65 gph to 1624 gph*



SERIES 200
Self-contained lubricating system—no downtime for lubrication. E.Z. Clean Cartridge liquid end simplifies maintenance. Simplex models pump up to 812 gph at a maximum pressure of 10,000 psi. Duplex models double that capacity.

American controlled capacity proportioning pumps have repetitive metering accuracy of plus or minus 1%, when operating between 10% and 100% of capacity. Feed precisely metered fluids or slurries in virtually all ratios, with flow, temperature, pressure, conductivity, pH and other controlled process variables.

- interchangeable liquid ends
- spherical self-aligning bearings on crank and crosshead handle greater radial and axial thrust loads
- crossheads of hardened and ground steel ride on cast iron
- nylon dust covers protect bearing surfaces
- NEMA frame motors
- heavy duty reducers



SERIES 100
Simplex models pump up to 13.10 gph at a maximum pressure of 1000 psi. Duplex models double that capacity.

**AMERICAN®**
**METER COMPANY**
INCORPORATED (ESTABLISHED 1836)
*pump division*
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## LITERATURE . . .

**Controls**.....Instrumentation, both pneumatic and electronic plus engineering and service. The complete story on this can be found in Bul. 13-18.
28-29 *The Foxboro Co.

**Controls**..... from the rugged simplicity of self-ops to the complicated requirements of an indicating controller. Temperature & pressure controls shown in Cat. A-VW.
291 *Robertshaw-Fulton Controls

**Controls, Temperature**.....A handy, condensed catalog of the complete line of temperature controls & allied equip. for industrial heating & refrigeration.
309 *The Partlow Corp.

**Data Processing System**.....Detailed literature on the G-20 data processing system. Has a complete line of accessory equipment including keyboard, paper tape, etc.
148 *The Bendix Corp., Computer Div.

**Gauge**.....Mastergauge is standard bearer for the broad line of Marsh Gauges for every service. Feature "Conoweld" leak-proof, one-piece tubing & socket. Catalog.
TL324 *Marsh Instrument Co.

**Industrial Digital Computer**.....The new, all-solid-state 290 Industrial Digital Computer rounds out the broad line of instrumentation for process control system.
18-19 *Minneapolis-Honeywell

**Instrument**.....The Magnarator is a metal or glass tube rotameter that clearly indicates flow rate and transmits a linear pneumatic output signal as well. Cat. 10A2150.
145 *Fischer & Porter Co.

**Instrument**..... Radionic for positive on-off control & determination of liquid or solid level within a closed vessel or piping using nuclear radiation. Bul. 558.
BL337a *Instruments, Inc.

**Instrument**.....Electr-o-probes are now in use for detection of liquors & foam in pulp & paper mills; heavy fluids, acids & fluid interface in chemical plants, etc. Bul. B-06.
BL337b *Instruments, Inc.

**Liquid Level Controls**.....Floatless, electrode type liquid level controls are unaffected by acids or caustics. A 32-page Catalog gives complete specifications.
BL333 *Charles F. Warrick Co.

**Meters**.....Type 316 stainless steel meter for measuring liquid fertilizer & corrosive chemical solutions. Many features covered in descriptive literature.
T335 *Badger Meter Mfg. Co.

**Meters**.....Electricontact Meters offer absolute batch or process uniformity. Complete information contained in Catalog which is now offered.
258 *Buffalo Meter Co.

**Oxygen Analyzer**.....Uses a direct paramagnetic measurement exclusively. Data File 14-47-08 contains detailed specification on this oxygen analyzer.
60 *Beckman Instruments, Inc.

**Pyrometers**.....A complete line of pyrometers; radiation, thermocouple and resistance models and accessories are offered for every temperature range. Complete data.
58 *The Bristol Co.

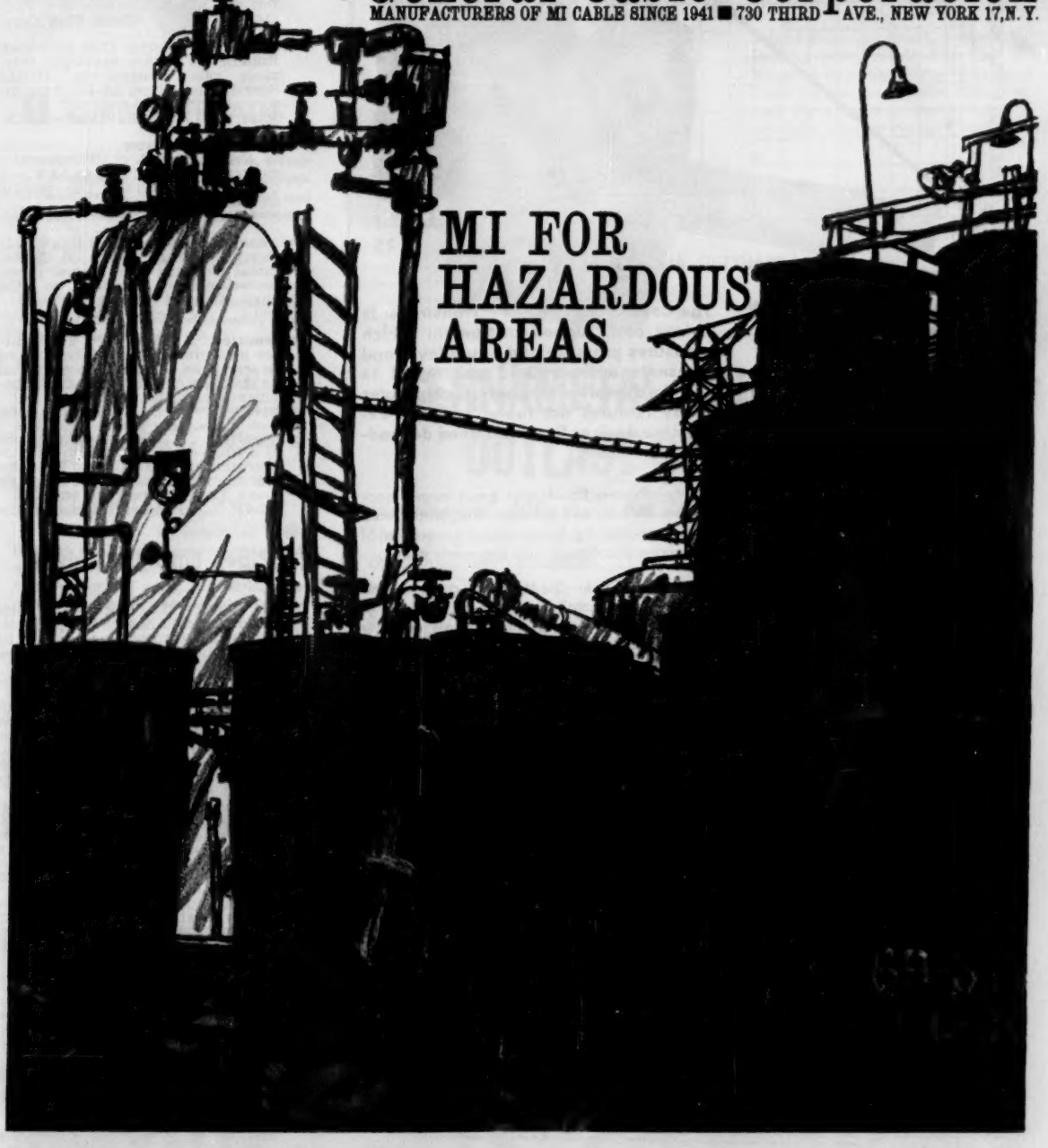
* From advertisement, this issue.

Oil companies throughout the country specify Safety MI Cable for hazardous applications and for remote control and instrumentation. Outstanding design engineers recommend it. One four-part reason... MI's exceptional record of safety, efficiency, permanence and economy. ■ Investigate the many unique characteristics of this versatile cable construction by writing for the new MI catalog

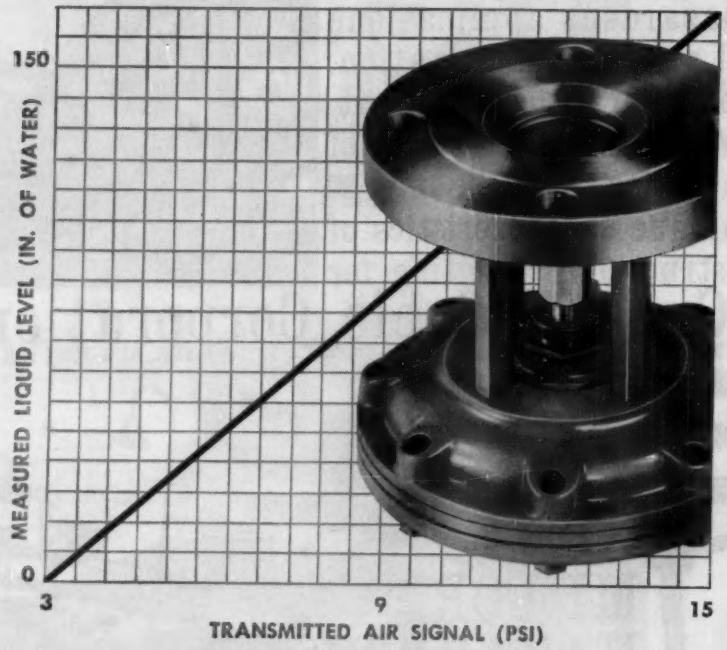


General Cable Corporation

MANUFACTURERS OF MI CABLE SINCE 1941 ■ 730 THIRD AVE., NEW YORK 17, N. Y.



TYPICAL PERFORMANCE CURVE OF MODEL "P" TRANSMITTER




# LOW COST PRESSURE AND LIQUID LEVEL TRANSMITTER WITH QUALITY FEATURES FOR DEPENDABLE OPERATION

**The Conoflow Model "P" Transmitter is a low cost, rugged instrument which measures pressure and liquid level and transmits a *linear* 3-15 psi signal to standard receiver elements. Incorporates many features not found in more expensive devices for guaranteed dependable operation.**

***Safety***—Process liquids and gases cannot back up into air lines and damage costly instruments. This is assured by the complete separation of measuring diaphragm from pneumatic pilot.

***Simple Installation***—The Model "P" can be mounted either horizontally or vertically on open or closed vessels. No dip tubes, floats or other mechanical devices are required inside the tank.

***Long Life***—Only the corrosion-resistant *Inconel X* diaphragm is exposed to the measured material. Preformed diaphragm will not work-harden or fatigue; withstands pressures to 500 psi and temperatures to 450°.

***Versatile***—Can be used for practically any service; ideal for viscous fluids or materials with solids in suspension; also for flowing bulk materials such as pigments, flakes, etc.

***Choice of Ranges***—Available for measuring ranges as low as 0 to 100" of water and pressures as high as 250 psi. Ranges can be changed in the field.

***Specifications***—New Bulletin P-36-1 contains complete specifications on the Conoflow Model "P" Transmitter. Write for your copy today or ask for a quote. No obligation. Conoflow Corporation, 2100 Arch Street, Philadelphia 3, Pa.

CC-1003

**CONOFLOW CORPORATION**
*FOREMOST IN FINAL CONTROL ELEMENTS*
SUBSIDIARY WALWORTH


LITERATURE . . .

**Pressure Gauge**.....The direct-drive helical bourdon gauge offers pressure ranges from 0-1000 to 0-10,000 psi. Additional information can be found in the general catalog.
261 *Rochester Mfg. Co., Inc.

**Pressure Indicating Switch**.....The 257 differential pressure indicating switch is accurate, responsive, easy to read & infinitely dependable.
279 * Barton Instrument Corp.

**Reflux Splitter**.....for more accurate process control is available in Column and In-Line designs, as well as other materials of construction. Bul. RS-2.
316 *Chem Flow Corp.

**Rotameter**.....Series 1112 Full-View Rotameters feature dowel-pin, side-plate case construction. Design Specification Sheet SS-111-2 for information.
R320 *Brooks Rotameter Co.

**Temperature Regulator**.....available in sizes ½" to 1½". Temperature ranges as low as 15 F. to 50 F.—as high as 240 F. to 350 F. Information in Bulletin 114 A.
181 *Manning, Maxwell & Moore, Inc.

**Thermometers, Dial**.....are thoroughly dampened with silicone on the bi-metal elements & a special precision-machined bearing on the shaft. General Catalog.
260 *Rochester Mfg. Co., Inc.

**Transmitter**.....Model "P" Transmitter measures pressure & liquid level & transmits a linear 3-15 psi signal to standard receiver elements. Specifications in Bul. P-36-1.
314 *Conoflow Corp.

**Transmitter**.....The new Transcope is a high-accuracy, motion-balance transmitter for Gage Pressure, Volumetric Pressure, Volumetric Load, Temperature. Bul. 98385.
46-47 *Taylor Instrument Co.

## Pipe, Fittings, Valves

**Duplex Tubes**....The new 20-page fact-filled book tells how to lick problems involving corrosive media . . . by using bi-metal Duplex Tubes. Available on request.
77 *Bridgeport Brass Co.

**Expansion Joints**.....Catalog 56 contains complete & comprehensive engineering data for Expansion Joints from 3" to 50' diam., pressures to 3600 psi, temp. to 1600F.
163 *Zallea Brothers

**Fittings**.....A complete line of Parker-ized Fittings in sizes ⅛" to 4" resist corrosion on shelf or in high-pressure steam, water, oil, gas & air applications.
16-17 *Clayton Mark & Co.

**Fittings**.....Speedline Fittings have been specially designed for use with light wall pipe. Made to meet critical standards. Complete catalog on request.
141 *Horace T. Potts Co.

**Fittings & Flanges**.....Pipe-Mate bulletin describes the complete line of fittings & flanges, shows installation procedures, & gives properties & dimensional tolerances.
30-31 *Tube Turns Div. of Chemetron

* From advertisement, this issue.

# DARNELL
## CASTERS & WHEELS
have all these advantages

**1 RUBBER TREADS**

. . . a wide choice of treads suited to all types of floors, including Darnelloprene oil, water and chemical-resistant treads, make Darnell Casters and Wheels highly adapted to rough usage.

**2 RUST-PROOFED**

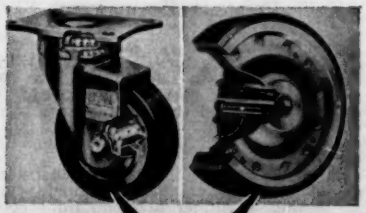
by zinc plating. Darnell Casters give longer, care-free life wherever water, steam and corroding chemicals are freely used.

**3 STRING GUARDS**

. . . Even though string and ravelings may wind around the hub, these string guards insure easy rolling at all times.

**4 LUBRICATION**

. . . all swivel and wheel bearings are factory packed with a high quality grease that "stands up" under attack by heat and water. Zerk fittings are provided for quick grease-gun lubrication.



FREE MANUAL — For the full story

Look in the Yellow Pages for your Darnell Distributor under "Casters".

DARNELL CORPORATION, LTD.

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36 NORTH CLINTON ST., CHICAGO 6, ILL.
1000 PEACHTREE N. E., ATLANTA, GA.





Slight misalignment, caused by bearing wear, resulted in the ¼" ridge on opposite edges of each of these Kennametal Rolls. However, note the even wear and absence of grooving on the contact surfaces.

# KENNAMETAL* CRUSHER ROLLS OUTLAST STEEL 72 TO 1

Working two shifts daily for 72 weeks, these Kennametal Crusher Rolls processed over a million pounds of highly abrasive aluminum oxide and ferro tungsten. Then they were removed, reground and put back into service. In the same operation, steel crusher rolls became grooved after only one week, and had to be removed.

In another application, extremely abrasive aluminum nickel alloy—used in permanent magnets—was successfully reduced by Kennametal tungsten carbide rolls to —100 mesh with no contamination. *High iron contamination encountered with previously used steel crusher rolls was eliminated.*

Kennametal has a YME up to 94 million psi . . . 3 times that of hardest steel. Chances are this extreme hardness, plus great resistance to abrasion and deformation can save *you* money through increased roll life and the virtual elimination of contamination.

Find out how Kennametal is used for other applications where contamination and severe wear are problems. Write for Booklet B-666, "Proven Uses" (more than 80 applications of Kennametal), KENNAMETAL INC., Dept CE, Latrobe, Pennsylvania. 33990

*Trademark

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...Partners in Progress




for MORE ACCURATE PROCESS CONTROL

- Complete corrosion resistance
- Full visibility for ultimate product control
- Teflon gate is only moving part
- Solenoid and timer for accurate performance

Construction of *Pyrex and Teflon makes this Reflux Splitter completely corrosion resistant to all liquids except Hydrofluoric Acid and hot concentrated caustics. Eliminates valves, product line and reflux line rotometers for greater economy. Available in Column and In-Line designs, as well as other materials of construction. Ask for Bulletin RS-2.

*T.M., Corning Glass Works

**CALL CHEM FLOW FOR TEFLON GASKETS**

Complete line of standard and special gaskets to solve any sealing problem. Solid Teflon and envelope type gaskets in all sizes. Regular and odd shapes in all materials.

Chem Flow

**CHEM FLOW CORP.**
193 Paterson Avenue
Little Falls, N. J.


LITERATURE . . .

**Flanges**.....Light weight forged carbon steel back-up flanges for use with schedule 5 and schedule 10 stainless steel stub ends and pipe. Schedule FCS-460 for prices & data.
R311 *Camco Fittings, Inc.

**Pipe**.....Saran Lined Pipe, fittings, valves and pumps are available for systems operating from vacuum to 300 psi, from below zero to 200 F. Information.
86 *Saran Lined Pipe Co.

**Pipe, Epoxy**.....A complete size range that handles a temperature range from 65 to 300 F. Withstands an operating pressure range up to 1200 psi. Information.
147 *Fibercast Co.

**Pipe & Fittings**.....with Fluoroflex-T are ideal for service to 500 F. Data on Fluoroflex-TS pipe & fittings for complete piping systems is offered.
251 *Resistoflex Corp.

**Tube Fittings**.....Hi-Seal is available in steel, stainless, aluminum and brass for ⅛" to 1½" O.D. tubing. Further information in Catalog 3108.
TL337 *The Imperial Brass Mfg. Co.

**Tubing, Bi-Metallic**.....for dual corrosion problems in heat exchangers & condensers. Full range of heat exchanger sizes, gauges & lengths available. Bul. BMT.
166a *The Carpenter Steel Co.

**Tubing, Integral-Finned**.....is suitable for straight-tube and U-tube bundles, coils and other tubular arrangements needed for heating or cooling functions. Bul. IFT.
166b *The Carpenter Steel Co.

**Valve**.....V-7 Pump Valve Units operate under temperature-pressure extremes, with corrosive fluids & in any position. Available in 17 sizes. Booklet CE110.
284 *Durabla Mfg. Co.

**Valve**.....Wafer type butterfly valve with spool type rubber liner, available in "Keelock" snap-in, easily replaceable type or vulcanizing to body. Bul. 583.
L272a *W. S. Rockwell Co.

**Valve**.....Flanged type butterfly valve with spool type rubber liner and worm gear manual operator. Further information can be found in Bul. 582.
L272b *W. S. Rockwell Co.

**Valve**.....The ¾" (Fig. 802) Self-Closing Ball Valve is designed for smooth, leakproof handling of highly flammable liquids. Complete details.
87 *Rockwood Sprinkler Co.

**Valve, Ball**.....The Econ-O-Miser Ball Valve is available from ¼" through 6" size range. Suited to difficult media because of its smooth round flow & quarter-turn operation.
93 *Worcester Valve Co., Inc.

**Valve Positioner**.....Type 3560 is small & compact and offers split range. Features convenient adjustment and is easily reversible. Bulletin E-3560.
97 *Fisher Governor Co.

**Valves**.....New split-body valve makes possible a flexible inter-mix of valves & actuators—a combination designed for perfect matching of valve to application. Bul. B-802-1.
52-53 *Minneapolis-Honeywell

**Valves**.....Gate, Globe and Check valves with hard faced seats feature interchangeable parts. Complete line of pressures, sizes & types. Literature.
182 *Henry Vogt Machine Co.

**Valves, Ball**.....Fullport Compression-Mounted Ball Valves are immediately available in stainless steel in sizes ½" through 6". Information in catalog #BVFA.
158 *Cooper Alloy Corp.

**Valves, Ball**.....Seven data sheets giving various information about a complete line of "Double-Seal" Ball Valves and accessories are now available on request.
71 *Jamesbury Corp.

**Valves, Ball**.....are available in carbon steel to ASA 300 lbs. (some sizes 600 lbs.), and in semi-steel, ASA 200 and 400 lbs. WOG. Catalog 1000 for further information.
63 *W-K-M Div. of ACF Industries

**Valves, Bronze**.....Complete information about these valves as well as the complete line of electric furnace iron, cast steel, bar stock and forged steel valves on request.
150 *R-P & C Valve Div.

**Valves, Butterfly**.....Heavy pattern butterfly valves with inlet pressures up to 6000 psi & pressure drops to 1200 psi are described in Bulletin No. 76.
BL335 *Fisher Governor Co.

**Valves, Line Blind**.....Hamer line blind valves offer fast, easy positive line blinding. The new Hamer Valve Catalog 60 is available.
R307 *Well Equip. Mfg. Corp.

**Valves, Rotary**.....A broader line of butterfly, ball and cone valves for industrial applications, power plants, sewage & water works. Also complete valving systems.
269 *Allis-Chalmers

**Valves, Steel**.....Globe, Angle, "Flo-control", Lift Check and Hi-Pressure Drop designs are available. The 600# valve in sizes ¼" thru 2". Full details.
74 *Manning, Maxwell & Moore, Inc.

## Process Equipment

**Agitators & Mixers**.....Turbine-type propeller (to 120" in tanks to 50" dia.) slow speed, high speed, air lift, vertical turbine mixers, mixer-settler units. Bul. A2-B2.
280a *Denver Equipment Co.

**Attrition Mills**.....8-page illustrated technical catalog on single and double runner attrition mills contains dimensions, weights and capacity specifications, etc.
316A Young Machinery Co. Inc.

**Attrition Scrubbers**.....High power input to efficiently remove sand coating, mix dense slurries. Rubber lined or acid-proof tanks. Sizes to 56" x 56". Bul. A-8505.
280b *Denver Equipment Co.

**Centrifuge**.....AC-VO "Nozzle-Matic" continuous discharge centrifuges offer high capacities for recovery problems. Further information on request.
14-15a *The De Laval Separator Co.

* From advertisement, this issue.

LITERATURE . . .

**Centrifuge, Hermetic**.....Corrosion resistant and easy to clean, these centrifuges meet all the requirements of industrial service. Details on request.
**14-15b** *The De Laval Separator Co.

**Compacting Process**.....This process produces granules that are more uniform in size . . . granules that flow freer, won't fracture or abrade in handling. Information.
**271** *Allis-Chalmers

**Crusher Rolls**.....Kennametal Crusher Rolls & Kennametal for other applications where contamination and severe wear are problems are covered in Booklet B-666.
**R315** *Kennametal Inc.

**Crushing & Grinding**.....Bulletin No. 067 gives a full description of all laboratory machines including Crushing Rolls, Jaw Crushers, Swing-Sledge Mill, & Sample Grinder.
**R337** *Sturtevant Mill Co.

**Dryer**.....The new SCL features: greater accessibility, tighter housing, improved air circulation, new heater design, etc. New SCL Dryer Bulletin No. 462 offered.
**129** *Proctor & Schwartz, Inc.

**Dryer, Desiccant**.....Series "A" is an adsorptive type dehydrator designed to remove moisture from compressed gases under pressures ranging from 1000 to 600 psig. Bul. D-108.
**317A** C. M. Kemp Mfg. Co.

**Dryers**.....Data Sheets are available which describe typical humidity control installations. They'll serve as guides in planning your own systems.
**292** *Pittsburgh Lectrodyer Div.

**Dryers**.....Heat-Les Dryers are available in standard models ranging from 2 SCFM to 5000 SCFM. Units up to 200 SCFM are available from stock. Technical Manuals.
**281** *Trinity Equipment Corp.

**Dust Control**.....Sonic cleaning provides three operating advantages; lower back pressure, longer bag life, & lower maintenance. Further information.
**90** *Dracco Div. of Fuller Co.

**Dust Filters**.....The Dynaclone operates continuously & provides 20 to 40% more cloth. Automatically self-cleaning by reverse air. The 36-page Catalog 104 offered.
**308** *The W. W. Sly Mfg. Co.

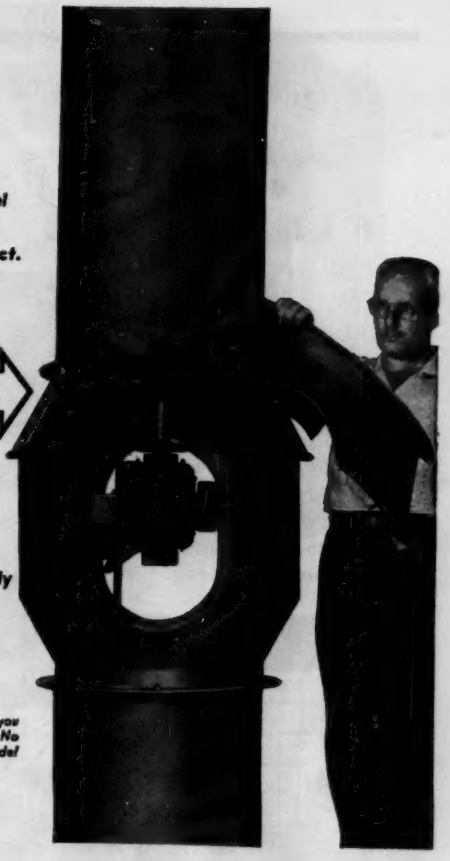
**Evaporators**.....for all chemicals . . . acids, salts, pharmaceuticals, recovery of industrial waste. A complete range of designs. Details in Catalog 372.
**299** *Blaw-Knox

**Filter**.....With the EimcoBelt filter, operation is continuous, with no blinding and no fall-off in filtration rate. Bulletin F-2053 is offered.
**Cover** *The Eimco Corp.

**Filter**.....Vibra-shoc or Recipro-shoc cleaning is available on Type 152 filters as well as quick opening covers, liquid shoc and air wash. Bulletin EP-100.
**154** *Industrial Filter & Pump Mfg. Co.

**Filters**.....Durco-Enzinger dry cake discharge filters are designed for simple, fast recovery of even the heaviest cakes. Listing of filtration equipment in Bul. EF/2a.
**247** *The Duriron Co., Inc.

* From advertisement, this issue.

*Now . . . pull the fan wheel or motor while DeBothezat® Bifurcator® Fan remains in duct.*

*Not just an access door. Half the entire cone comes off.*

*Speed up inspection . . . slash maintenance and downtime costs.*

*This removable cone design is an exclusive feature found only on DeBothezat Bifurcator Fans.*

*Published ratings on DeBothezat Fans tell you exactly what the complete fan unit puts out. No guess work — no allowance to be on safe side!*

# New design duct fan

## De Bothezat® FANS

DIVISION OF
American Machine and Metals, Inc.
EAST MOLINE, ILLINOIS

**Divisions of American Machine and Metals, Inc.**
TROY LAUNDRY MACHINERY • RIEHLE TESTING MACHINES • DEBOTHEZAT FANS • TOLHURST CENTRIFUGALS • FILTRATION ENGINEERS • FILTRATION FABRICS • NIAGARA FILTERS • UNITED STATES GAUGE • RAHN INSTRUMENTS • LAMB ELECTRIC COMPANY • HUNTER SPRING COMPANY GLASER-STEERS CORPORATION

**THIS COUPON ANSWERED WITHIN 24 HOURS**

**DeBOTHEZAT FANS DIVISION, Dept. CED-1160**
**American Machine and Metals, Inc.**
**East Moline, Illinois**

**Gentlemen: Your new Removable Cone feature for DeBothezat Bifurcator Fans looks good to me. Please rush descriptive literature at once.**

NAME

FIRM NAME

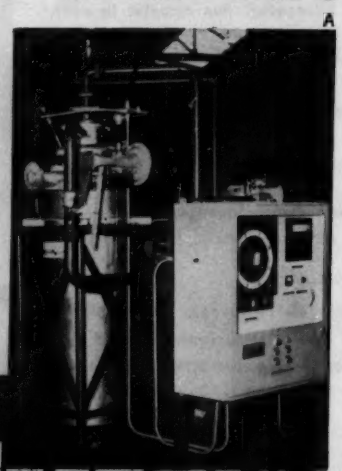
ADDRESS

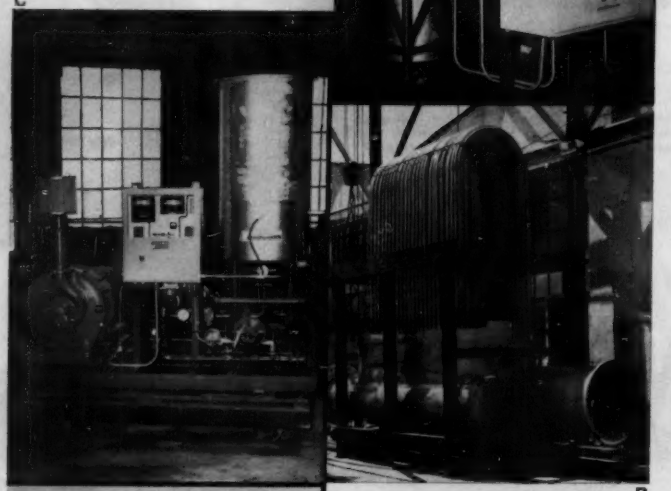
CITY & ZONE STATE

for chemical processing requirements...

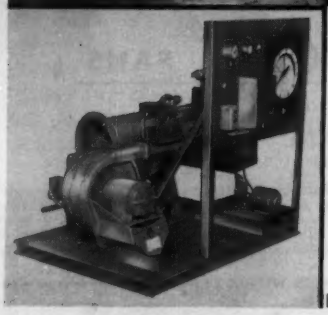
# THERMAL
## FIRED AIR HEATERS

THERMAL's versatility in the design and construction of fired air heaters meets all specialized requirements of the chemical and petrochemical industries. Direct or indirect fired, they may be operated on oil or gas to produce temperatures to 1900 F, flows to 500 lbs/sec, and pressures to 5000 psig.


A


C

B


D

A. Fully packaged 1,500,000 btu/hr indirect type air heater including all controls.

B. Tube bundle in fabrication (inverted) for a 150 lbs/sec, 900 F 150 psig air heater.

C. Direct fired heater for 6,000,000 btu/hr 3 psig pressure including all controls.

D. Completely "packaged" 600,000 btu/hr air heater to provide a wide range of outlet temperatures from 600 F to 1600 F for aircraft parts test work.

For further information write for Bulletin 113 (indirect fired) • 112 (direct fired)

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**Thermal Research & Engineering Corp.**

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*Other Thermal Products & Services:*

- Gas, Oil & Combination Burners
- Heat Exchangers
- Air Heaters
- Gas Generators
- Submerged Combustion
- Combustion & Heat Transfer Equipment

LITERATURE . . .

**Floats**.....A complete line in a wide range of sizes, shapes, spud connections, in copper, brass, monel, stainless, aluminum, steel & nickel. Bulletin.
**BR324** *Chicago Float Works

**Hammer Mill**.....with extra heavy manganese steel liners & breaker plates, oversize shafts, massive parts & reinforcements which defy shock & wear, reduce downtime. Catalog.
**89** *Williams Patent Crusher

**Homogenizers**.....provide the practical solution to particle control. Bulletins on Homogenizers H-55, Sub-Micron Dispersers SMD-55 & Colloid Mills C-57 available.
**332a** *Manton Gaulin Mfg. Co., Inc.

**IMP Hill**.....Catalog No. 87E shows the many applications of this multi-purpose unit . . . and how it can be adapted to your pulverizing job. Available now.
**180** *Combustion Engineering, Inc.

**Jar Rolling Machine**.....are available to handle single or parallel rows of jars, & in double or triple tiers for processing as many jars as required. Catalog 79.
**L262** *Abbe Engineering Co.

**Jaw Crusher**.....with cast steel frame, anti-friction side bearings and bumper bearings are covered in detail in Bulletin C12-B12. Sizes from 2¼" x 3½" to 36" x 48".
**280d** *Denver Equipment Co.

**Kilns & Slakers**.....feature advanced design for operating economy. In daily use by the processing industries. Additional information in Bulletin No. 1115.
**32** *Traylor Engineering & Mfg. Co.

**Laboratory Homogenizer**.....Minimum sample one pint; capacity 16 GPH; pressures up to 8000 PSI. Additional information is contained in Bulletin LH-55.
**332b** *Manton Gaulin Mfg. Co., Inc.

**Mills, Ball & Rod**.....in sizes 10' x 20'. All steel construction for wet or dry grinding systems. Additional information contained in Bul. B2-B20.
**280c** *Denver Equipment Co.

**Mixers**.....Ko-Kneaders mix a variety of products such as plastics, carbon electrodes, food specialties, floor tile, solid rocket propellant fuels, etc. Manual K-57.
**85** *Baker Perkins Inc.

**Mixers**.....The new Model RL Shear-Flow portable mixer emulsifies immiscible liquids and handles viscous materials with ease. Complete information offered.
**306** *Gabb Special Products Inc.

**Mixers**.....Bulletin LL-60 contains full information on how these lifting-lowering mixers can improve the effectiveness of your mixing operations.
**36** *Philadelphia Gear Corp.

**Pressure Filter**.....Vallez rotating leaf pressure filters were designed specifically for removing color & purifying corn syrup. Information on this & other equipment.
**338** *Goslin-Birmingham Mfg. Co.

**Process Equipment**.....Equipment for efficient and economical cleaning and handling of air and gas. Further information on the products of interest.
**288** *Aerotec Industries Inc.

* From advertisement, this issue.

**Process Equipment**.....“Sub-A” Flotation is available in sizes from 16” x 16” to 72” x 72”. “Cell-to-Cell”, “Free-Flow”, and Type “M” Bulletin F10-B86.
280f *Denver Equipment Co.

**Process Equipment**.....for any applications dealing with liquid-liquid, liquid-solid, liquid-slurry extraction . . . full information on RDC columns. Bul. T-1159.
265 *General American Transportation

**Process Equipment**.....The Turbulizer features heavy steel shell with machined interior, heavy duty outboard bearings, etc. Complete details on request.
143 *The Strong Scott Mfg. Co.

**Purifiers**.....Hi-eF purifiers prevent valuable particles from leaving evaporators & concentrators. Data on 13 types of purifiers, separators, mist extractors, scrubbers.
BL323 *The V. D. Anderson Co.

**Reagent Feeders**.....Both wet and dry feeders are available. Many standard units in stock. Complete information on these feeders in Bulletin F6-B8.
280e *Denver Equipment Co.

**Samplers**.....Continuous mechanical & automatic types for dry, solution or slurry sampling. Complete sampling plants & sample processing equipment. Bul. S1-B4.
280j *Denver Equipment Co.

**Screens**.....for efficient wet or dry screening. “True-Circle” eccentric action. Sizes to 6’ x 14’ in stock. Trommel Screens in sizes from 30” x 60” x 120”. Bul. S3-B15.
278k *Denver Equipment Co.

**Scrubbers**.....The Turbulaire-Doyle scrubbers give you jet-action gas-cleaning with no moving parts. Offer high collection efficiencies. Descriptive bulletin.
172 *Western Precipitation Corp.

**Spiral Rake Thickeners**.....move settled materials to center in one revolution. Acid proof construction available. Further information in Bul. T5-B6.
280l *Denver Equipment Co.

**Spray Nozzle**.....Uniform distribution with spray angle, capacity, impact & atomization to your specifications. Choice of over 12,000 basic designs. Catalog 24.
TL333 *Spraying Systems Co.

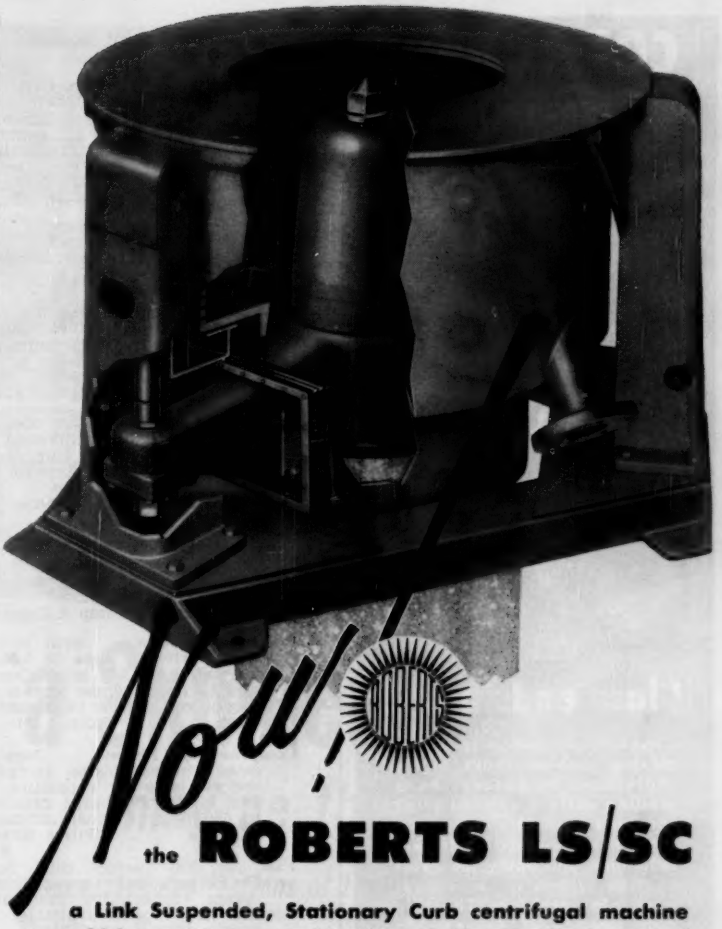
**Steam Jacketed Kettles**.....meet every processing & mixing need. Size & type for every process or product are covered in book of engineering data & specification sheets.
R339 *Groen Mfg. Co.

**Sterilizer**.....The new DUO-Door built-in dry heat sterilizer recesses between sterile & non-sterile areas. Available in 8 to 31 cu. ft. capacities. Bul.
BL303 *The Electric Hotpack Co.

**Tornado Mill**.....offers versatility in speed, in size of particles it handles, & in the rate of production. The 360 degree screen provides full working area.
278 *F. J. Stokes Corp.

**Water Process Equipment**.....A new Catalog #160 on Water Demineralizers and Catalog “G” on Stills and accessories for pure water are available on request.
266 *Barnstead Still & Sterilizer Co.

* From advertisement, this issue.

Now! the ROBERTS LS/SC

**a Link Suspended, Stationary Curb centrifugal machine which provides a combination of features long wanted by the Chemical Process Industries.**

*Features* . . . Link Suspension! No metal to metal moving parts. No lubrication. Soft lateral movement. No vertical movement. Effective damping. This suspension isolates dynamic parts from curb and foundation and reduces vibration to an astonishing low.

*Features* . . . Stationary Curb! With rigid feed, wash, effluent, and solids-discharge connections. No vibration damage to curb mounted accessories. Extends bearing life by reducing bearing loads. Increases personnel safety. Provides rapid drainage, more effluent capacity.

*Features* . . . Direct Coupled Hydraulic Motor! No belts. Compact. Light weight. Provides power for exclusive, slow speed, reverse discharging. Provides adjustable loading speed and adjustable top speed. Hydraulic braking (even at power failure). No brake linings to wear. Constant horsepower drive reduces peak electric loads.

*Features* . . . Oversize Anti-friction Bearings! Basket spindle bearing housing is air purged. This feature, designed to protect bearings from damaging effects of process material environment, also provides a convenient means for introducing controlled atmosphere within the basket. Can be grease lubricated while in operation. No-belt design — no belt-pull-loading on the bearings.

2905

Investigate its potential in relation to your operation. We will welcome the opportunity to co-operate with you.

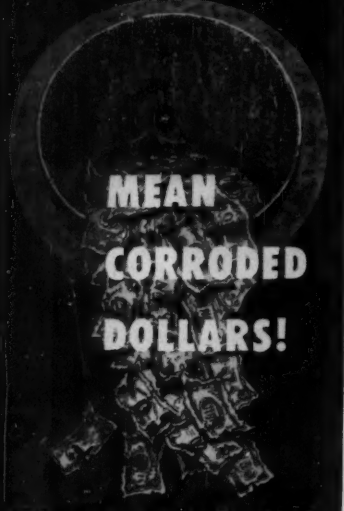
ROBERTS STEVENS

The WESTERN STATES MACHINE COMPANY

1700 Fairgrove Avenue

HAMILTON, OHIO, U.S.A.

# CORRODED UNITS




## Glaco ends both!

Corrosion prevention is a perplexing problem that's highly individual in nature. As a leading custom applicator of specialized plastic materials, Glaco's experienced staff will determine and apply the exact coating system to solve your particular problem. The thin film coatings of fluorocarbon and other unique plastic resins applied by Glaco, insure outstanding chemical resistance to both inorganic and organic agents — even up to temperatures of 400° F. Wherever you are, Glaco is near with coast-to-coast facilities to handle all your special coating requirements.

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The *Complete* Custom-Engineered Coating Service!

INDUSTRIAL COATINGS DIVISION
THE NATIONAL GLACO CHEMICAL CORP.
*(A Subsidiary of Ekco Products Co.)*
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1960

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**The National Glaco Chemical Corp.**
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**Chicago 39, Illinois**

☐ **Please send me a copy of your 12-page, full color brochure on custom-engineered coating service, without obligation.**

☐ **Have a sales engineer call on me.**

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**Title**_____

**Company**_____

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**City**_____ **Zone**____ **State**_____

CE-11160


LITERATURE . . .

**Wet Collector**.....Type N Roto-Clone combines action of centrifugal force & thorough intermixing of water & dust-laden air. Complete information in Bulletin 277.
**84** *American Air Filter Co.

## Pumps, Fans, Compressors

**Blowers**.....Bulletin describes line of turbo blowers built to give continuous service over a pressure range of 4 to 44 psi. Available in direct, v-belt or coupled drives.
**320A** The North American Mfg. Co.

**Compressor**.....Operating characteristics of 10,000 hp compressor given in 4-page brochure. Unit contains advanced cylinder designs for maximum working pressures.
**320B** Cooper-Bessemer Corp.

**Compressors**.....Booklet "Compressors for Industry" describes Pennsylvania Compressors from 10 to 350 hp, horizontal, angle, and Oilfre models. Available now.
**282** *Pennsylvania Pump & Compressor

**Compressors, Gas**.....with motor or steam drive in sizes to 5,000 h.p. Vacuum to 15,000 psig. Compressors to handle most known gases. Engineered to meet requirements.
**48-49** *Chicago Pneumatic

**Compressors, Piston**.....Non-lubricated ringless piston compressors are available for capacities up to 4000 cfm & discharge pressure up to 650 psig. Further information.
**TL303** *Sulzer Bros. Inc.

**Fan**.....New design dust fan by De Bothezat has a removable cone design. Descriptive literature on this new type is available on request.
**317** *American Machine & Metals, Inc.

**Fan**.....Type FG features flanged inlet & outlet. Capacities up to 34,000 cfm. & pressures up to 10" static. Bul. FI-511 for details & chemical resistance table.
**33** *Buffalo Forge Co.

**Pump**.....SRL (Rubber Lined) pumps offer high efficiency, low horsepower. Sizes to 5000 g.p.m. Additional information in Bulletin P9-B10.
**280i** *Denver Equipment Co.

**Pump**.....New positive displacement handles without turbulence, pulsation, aeration or agitation, corrosive-problem liquids of high or low viscosity. Catalog P 302.
**127** *Waukesha Foundry Co.

**Pump, Sump & Process**.....Specifications, sectional views, construction materials, performance curves, dimensions are all clearly given in Bulletin 726.2.
**289c** *Goulds Pumps, Inc.

**Pump, Vertical Centrifugal**.....for handling frothy liquids or coarse, sand slurries, constant or intermittent flow. Capacity to 450 gpm. Bulletin P10-B5.
**280h** *Denver Equipment Co.

**Pumps**.....Catalog E contains complete information on the extensive line of industrial pumps that are available for your pumping requirements.
**96** *The Deming Co.

* From advertisement, this issue.


# NEW FULL-VIEW® ROTAMETER



Interchangeable metering tubes snap in and out . . . in seconds! It's that easy to change range or to service the new Brooks Series 1112 Full-View Rotameters.

A stainless steel leaf spring (entirely isolated from the process fluid) holds the tube perfectly in position, yet allows removal with just a simple up-and-out movement. No tools necessary.

Special O-ring construction and tube adapter assemblies make this time-saving convenience possible. Up to four different size metering tubes may be interchanged in a single case by merely changing adapters.

Like all Full-View Rotameters, the new Series 1112 features Brooks' dowel-pin, side-plate case construction. Thoroughly proven in service, this practical construction gives the meter case rigid strength, protects the glass metering tube from all line strain.

**For More Information, Request Design Specification Sheet SS-111-2**

**BROOKS ROTAMETER COMPANY**

BROOKS

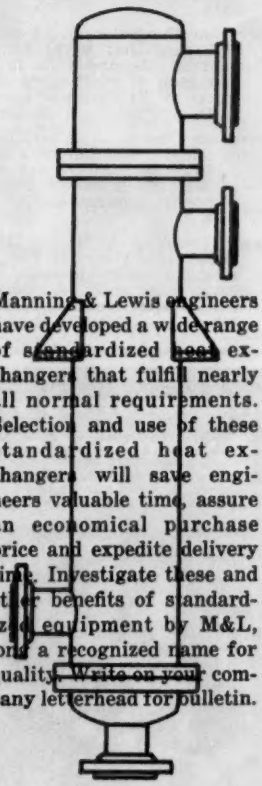
**1160 D STREET, LANSDALE, PA.**

9.A. 1937

# STANDARDIZED
HEAT EXCHANGERS
*by*

M&L

**A MARK OF QUALITY**



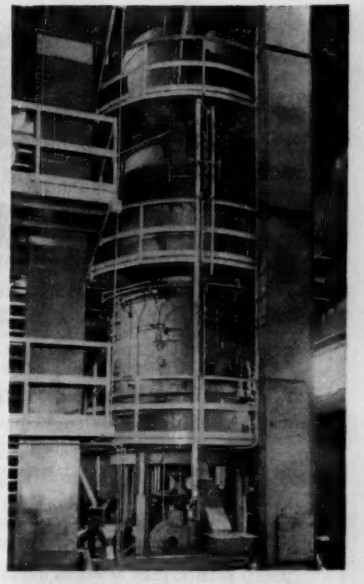
Manning & Lewis engineers have developed a wide range of standardized heat exchangers that fulfill nearly all normal requirements. Selection and use of these standardized heat exchangers will save engineers valuable time, assure an economical purchase price and expedite delivery time. Investigate these and other benefits of standardized equipment by M&L, long a recognized name for quality. Write on your company letterhead for bulletin.

In addition, a new four-color bulletin describes and illustrates the complete M&L line. Specify Bulletin 820 in your request.



M&L **MANNING & LEWIS Engineering Co.**

Dept. A, 675 Rahway Avenue
Union, New Jersey



# If you have a Drying, Roasting, Calcining or Decomposing problem...

# a Skinner Furnace

## *may be the answer*

***Successful applications of the Skinner Furnace include:***

**Oxidizing Roast**
- Roasting Molybdenum Sulphide Concentrates
- Roasting Zinc Ores
- Calcining of Basic Alum, Clays, Foundry Sand, Carbon, etc.
- Incineration of Sewage

**Chloridizing Roast**
- Roasting Uranium-Vanadium Ores

**Reduction Roast**
- Decomposition of Oil Sludge
- Lime Burning
- Manganese Reduction

**Drying**
- Drying Uranium-Oxide Precipitate
- Drying Copper Concentrates
- Dehydration of Alunite

***Many other applications are possible*** ***because of the flexibility in construction and operation of the Skinner Furnace...***

- 2 to 14 hearths
- 4'0" to 23'6" dia.
- 22 to 4000 sq. ft. hearth area
- Direct or indirect fired with coal, oil or gas
- Variable rate of feed and retention time
- Up or down draft
- Handles any solids.. slimy, sticky, loose, coarse
- ¾" to minus 325 mesh material
- 200° F. to 2000° F... precise control of process temperature
- 100 to 50,000 lbs. per hour

***We are equipped to work with you on your problem...***
***...over 40 years experience***

*The Company that cares enough to give you the best!*

*WRITE TO MANUFACTURING DIVISION*

**MINE AND SMELTER SUPPLY CO.**

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**Sales Agents** in Peru, Chile, Philippine Islands, Japan, New York City (for Continental Europe) and in principal cities of the U. S

# What's News in Milling?



***New Super Series Morehouse Mills Produce Super Results for Chemical Processors***

Truly amazing production records are being reported for these new Morehouse Mills. Now grinding stones 1" greater in diameter increase production over 50%. Engineering refinements make them more efficient and economical than ever.

Here are just a few of many examples.

*Stable Fertilizer Solutions*—Fast, controlled, particle-size reduction accomplished by liquid fertilizer concern. Suspension passed through Morehouse Mill showed improved qualities due to grinding of insoluble materials to particle size desired and more thorough dispersion.

*Brighter, Smoother, Paper Coatings*—Famous producer of paper coatings reports Morehouse Super Series Mill contributes to smooth, de-aggregated, non-sandy finishes. Improvement over other methods noteworthy in brightness, opacity and other qualities.

*Powder for Chocolate Syrup Processing*—When cocoa powder used in the manufacture of chocolate syrups calls for further reduction to finer particle size, call on a Morehouse Super Series Mill. Widely used for this purpose, they produce big volume, aid quality control. Stainless steel construction is recommended.

*Clay Slurry Milling Is Efficient*—Large southern ceramics concern, employing three Morehouse Mills now, contemplates additional because of successful results. Now producing over 1000 tons of clay slurry per month with business going up—costs down.

*Paint Volume Greatly Increased*—Spectral volume increases reported by many manufacturers with new Super Series Morehouse Mills models 520 VHV and 720 VHV. Faster particle-size reduction for finely ground products. Particularly good results on finish-off after pre-mix in Cowles Dissolvers.

***Let us prove the advantages of Morehouse Mills in your plant—at our risk!***

Write us today about your problem.

**MOREHOUSE-COWLES, INC.**
1150 San Fernando Rd.
Los Angeles 65, Calif.

*Representatives in Principal Cities. Convenient Lease and Time-Payment Plans.*

Please send me information on use of Morehouse Mills in processing (product).....

Name..... Title.....

Firm.....

Address.....

City..... Zone..... State.....626


LITERATURE . . .

**Pumps**.....Complete information on how Model 3171 can help you move uncooperative solids is contained in Bulletin 726.2 which is available.
289a *Goulds Pumps, Inc.

**Pumps**.....Model 3655 is available in 23 sizes with capacities to 2000 gpm, heads up to 400 ft. Pump & motor are a single, compact unit. Bulletin 710.1.
289b *Goulds Pumps, Inc.

**Pumps**.....New bulletin on Q and SQ pumps explains how either of these units can help to reduce liquid-handling costs in your plant. Available on request.
72 *The LaBour Co., Inc.

**Pumps**.....Manual contains 40 pages of indexed information, charts, graphs to help find the answers in pump selection, installation and application.
322A Marlow Pumps

**Pumps**.....Liquid abrasive pumps are specially designed with ceramic bearings & mechanical seals to pump paints, inks & other abrasive liquids. Bul. SP-507-C.
BR322 *Viking Pump Co.

**Pumps & Compressors**.....Units are available for all types of gases including highly toxic, corrosive & radioactive gas at pressures to 30,000 p.s.i. Bul. 4371-C.
245 *American Instrument Co., Inc.

**Pumps, Centrifugal**.....Bulletin describes and illustrates multi-stage, opposed-impeller, centrifugal pumps to handle hydrocarbons, chemicals, acids and similar liquids.
322B Pacific Pumps, Inc.

**Pumps, Diaphragm**.....Stroke can be adjusted while pump is operating. Sizes 1" to 10" simplex and duplex, capacity to 1000 g.p.m. Bulletin P8-B12 offered.
280g *Denver Equipment Co.

**Pumps, Diffusion**.....12-page catalog contains basic descriptive information on diffusion and booster pumps, shows speed curves and includes tabular specifications.
322C NRC Equipment Corp.

## Services & Miscellaneous

**Casters & Wheels**.....with a wide choice of treads suited to all types of floors. Rustproofed by zinc plating. The full story can be found in Manual.
L315 *Darnell Corp.

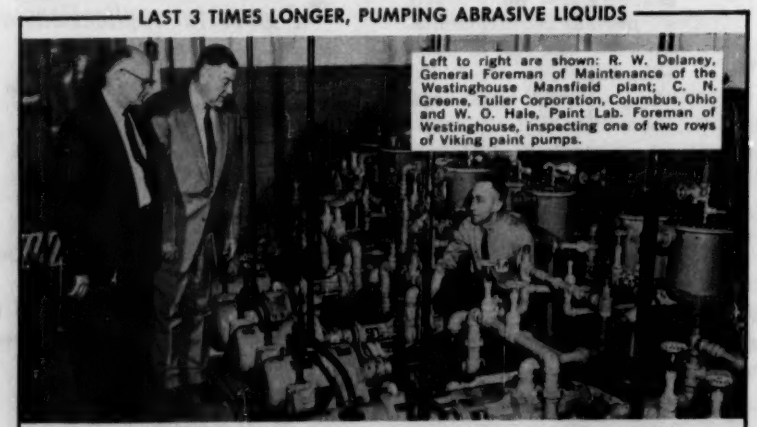
**Corrosion Computer**.....4 inch by 8 inch card that works similarly to a slide rule and tells in seconds how each of eight types of metals reacts to 141 chemical agents.
322D H. M. Harper Co.

**Corrosion Charts**.....Corrosive effects of almost 400 different materials on 16 types of metals are contained in bulletin prepared with multi-company cooperation.
322E Nooter Corp.

**Tank Cleaning Unit**.....Model 531 automatically sprays hot cleaning solution under pressure. Nozzles rotate vertically & horizontally. Rinses after cleaning. Details.
298 *Oakite Products, Inc.

* From advertisement, this issue.


**LAST 3 TIMES LONGER, PUMPING ABRASIVE LIQUIDS**



Left to right are shown: R. W. Delaney, General Foreman of Maintenance of the Westinghouse Mansfield plant; C. N. Greene, Tuller Corporation, Columbus, Ohio and W. O. Hale, Paint Lab. Foreman of Westinghouse, inspecting one of two rows of Viking paint pumps.

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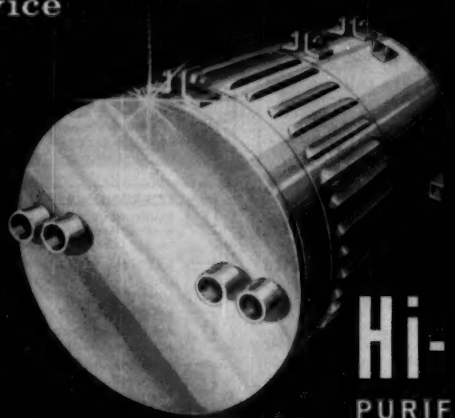
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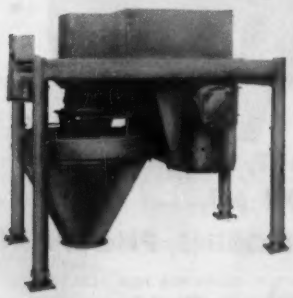
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Komarek Greaves Briquetting Presses
Birmingham-Farrell UNUSED 2 Roll Mills, 14"x30"
Stainless Drum Flaker 8" x 11½" with Scraper
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Multi Pass Jacketed 12" Screw Conveyor; 4 Sections 10' S/S Troughs

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**1—700 sq. ft. Buflovak 304 S. S. forced circulation Evaporator.**
1—550 sq. ft. Buflovak monel single effect Evaporator.
**1—7500 gal. 316 S.S. Vert. Storage Tank, 7' x 25', 50 psi.**
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**6—7500, 6000 and 2000 gal. Rubber Lined Tanks.**
**4—1000 gal. 304 SS Tanks, 5'6" x 6'.**
1—1500 gal. Stainless Pressure Tank, 5' x 10', 90#.
1—2,000 gal. horiz. 304 S.S. tank 5' x 12'.
1—2500 gal. vertical 304 S.S. Tank, 8' x 7'.
1—12,000 gal. horiz. steel Pressure Tank, 7'6" x 36', 200 psi.
6—Stainless Heat Exchangers; 1220, 786, 536, 370, 315, 250 sq. ft.
1—24" dia. x 35', 304 S.S. Bubble Cap Column.
**1—Pfaudler 100 gal. glass lined jacketed agitated Reactor.**

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**2—Louisville 8' x 50' Stainless Steel lined Rotary Dryers.**
9—Rotary Dryers 34" x 30', 4' x 40', 6' x 50', 6' x 60', 7' x 80', 8' x 87'.
1—Traylor 30" x 18' Stainless Steel Rotary Dryer.
2—Link Belt, 7'5" x 25', 6'4" x 24", S.S. Louvre Dryers.
2—Atmos. Tray Dryers, 16 shelves, 40" x 24".
1—P&S 10' wide Apron Conveyor Dryer 48' long.
2—10' and 4' dia. 304 S.S. Spray Dryers.

### MIXERS

**1—Farrel-Birmingham "Midget" Banbury Mixer.**
**2—Day Imperial 150 gal. jktd. double arm.**
1—Baker Perkins 100 gal., jacketed, double arm, 30 HP.
**1—Baker Perkins #16TRM, 150 gal. jktd., Vac. 60 HP.**
1—Baker Perkins 50 gal. jacketed, double arm.
**1—Baker Perkins 10 gal. jacketed 304 S.S. double arm.**
5—Day "Cincinnatus" double arm, 250 and 100 gal.
2—Steel jacketed Powder Mixers, 225 and 350 cu. ft.
1—Patterson 6' dia. Conical Blender 15 HP.
1—3' dia. Simpson Intensive Mixer.
**1—Stokes 21K, 304 S.S. Granulating Mixer 82 gals.**

### MISCELLANEOUS

1—Farrel Birmingham 8" x 16", 2 Roll Chrome Plated Mill.
4—Mikro Pulverizers 4TH, 1 SH, 1 SI and Bantam.
3—Abbe 2½' x 3' porcelain lined Pebble Mill XP motor.
1—Raymond 10" vert. Mill, 10 HP.
1—No. 1 Ball & Jewell Rotary Cutter.
1—#18 Cumberland Rotary Cutter.
3—Swenson Walker Continuous Crystallizers, 24" x 30' sections.
**1—#24 Rotex Sifter, 20" x 64", Quadruple deck.**
**1—#81 Day Roball Sifter 40" x 120" single deck.**
3—Nash H6 Vacuum Pumps.
25—Chlorimet, Durimet and Duriron Centrifugal Pumps 1½" to 6".
5—Day Roball Sifters, 40" x 120", 40" x 84", Double Deck.

***Partial List of Values — Send for Complete Circular***

TEXAS OFFICE: 4101 San Jacinto St., Houston 4, Texas—Tel.: JAckson 6-1351

**BRILL EQUIPMENT COMPANY**
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Allis-Chalmers 6' x 50' Rotary S S Lined Dryer, ½" shell

6' x 20' Rotary brick lined Kiln. Welded Shell. Complete

Symons 2' Standard Cone Crusher, 30 HP Motor. Extra new parts

Patterson-Kelly 1 cu ft Twin Shell Blender, bronze, ½ HP Mtr

St Regis 3 Spout Valve Packer. Model 107 FC. 25 HP Motor

Bird 40" x 60" S S Horiz. Cont, Centrifuge. 50 HP Motor

A T & M 42" S S perf. basket Centrifuge, plow & bot dump 25 HP

1 Dorr-Oliver 3 Tray Thickener 60" dia. x 35" high. Complete

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## MODERN REBUILT MACHINERY

UNION Rebuilt Machinery Established 1912

Baker Perkins, Day, W. & P. Heavy Duty Mixers, 5 to 150 gal. caps., Jacketed and Unjacketed.
J. H. Day and Baily Dry Powder Mixers, 25 lb. to 2000 lb. capacities.
Stokes 90-D Automatic Stainless Steel Tube Filler and Closer.
Pneumatic Scale High Speed Automatic Cartoning Line with Feeder, Bottom Sealer, Top Sealer, Wax Liner, Interconnecting conveyors.
Standard Knapp, A-B-C, Ferguson and Ceco Case Sealers.
WRAPPERS: Package Machinery, Hayssen, Hudson Sharp, Battle Creek, Scandia, Wrap-King, all sizes and models.
Coating Pans—all sizes, including 24", 36", 38" and 42".
Colton 6 ft. diameter Stainless Steel Pan.
Stokes & Smith Models G1, G2, HG84, HG87 and HG88 Auger Powder Fillers.
Raymond "O" Pulverizer.
Mikro Pulverizers, Bantam, 1SH, 2TH, 3TH and 4TH.
Fitzpatrick Stainless Steel Comminuters.

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## LOEB OFFERINGS

Autoclave: 50 gal. Struthers Wells, st. st.
Centrifugal: AT6M 60" st. st. perf.
Dewaterers: Davenport 3A, bronze hd. 3 hp.
Disintegrator: Rietz RD18P, 75 hp.
Dryers: Devine 2 x 4' vac. drum, st. steel.
Dryers: Bowen lab. spray, st. steel.
Dryer: American atmospheric, 24 x 48".
Column: 24" x 22', 316 stain. steel.
Evaporator: Buflovak st. st., 84 sq. ft.
Filter: Sweetland #5 st. st. lined.
Filter: Oliver precoat 12 x 2" st. steel.
Filter: Eimco st. st. drum 16" x 12".
Filter Press: Shriver 24" St. steel.
Homogenizers-Disperser: Tri-Homo #10, #4.
Homogenizers: 25, 50, 125, 200, 1200 GPH.
Kettles: st. steel with and without ag.
Dopp 150 gal. dbl. act. agitator.
Mill: Fitz model D-6 st. steel, 7½ hp.
Mill: Lehmann 16 x 40" 3-roll high speed.
Centrifugal: Tolhurst 48" st. steel.
Mixers: Dbl. and sgl. arms sigma blade.
Dry Powder, various sizes.
Pumps: Rotary, gear, centrif., vacuum.
Percolator: Pfaudler 300 gal. st. steel.
Dryer: Proctor & Schwartz 6-tray st. steel.
Tablet Press: Stokes DD2, 23 station.
Vacuum Pans, 42" and 72" stain. steel.

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Abbe Eng. Jacketed 5' x 6' Ball Mill, chrome manganese steel. Price $2750.00.

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# LIQUIDATING CHEMICAL PLANT IN MASSACHUSETTS

*Partial List Includes*

**Three 300 H P, 150 PSI Cleaverbrooks package Boilers**

**Filter Presses**

**Five Chrome-plated double drum driers**

**One Rogers hydraulic knife grinding machine 100" travel with 10 HP and 3 HP Motor**

**Tanks**

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CIRCLE P ON READER SERVICE CARD

# LIQUIDATION ALCOHOL PLANT OMAHA, NEBRASKA

**MAJOR ITEMS**

5—Buflovak 42" x 120" dbl. drum dryers, ASME 160#
2—Bonnet 7' x 60' rotary dryers,
1—Bonnet 6' x 52' rotary dryer,
9—Davenport #1A #2A dewatering presses
2—French Oil screw extrac. presses,
2—Sweetland #12 pressure filters,
3—Lawrence 4" x 3" stainless centrif. pumps, 275 GPM @ 40' head
6—Shriver 48" Cast Iron P. & F. filter presses, (50) chambers, hydraulic closure, closed deliv.
2—19,900 sq. ft. quadruple effect calandria type evaporators, copper tubes, cast iron bodies, with preheater & finishing pan
6—Ansonia 691 sq. ft. dbl. pipe coolers, copper tubes
3—American 654 sq. ft. spiral steel heat exchangers
1—1500 sq. ft. horiz. exchanger, (480)—¾" OD copper tubes, copper T. S. & shell, steel heads
18—Tubular heat exchangers, copper tubes: 1500, 1350, 1130, 637, 380, 290, 184, 176, 156 sq. ft.
1—ACME 96" dia. x 44' high copper beer still column, (20) perforated & (4) bubble cap trays
5—Leader Iron 96" dia. steel rectifying columns, 44' & 51' high, bubble cap trays
2—9500 gal. horiz. cookers, 9' dia. x 20' long, ½" shell & dished heads, agits.
4—Wallace & Tiernan auto. bulk handling scales
10—Forster hammermills, #8 & #6, 100 & 75 HP.
1—Stedman 36" dia. 3-row cage mill disintegrator
1—Prater "Blue-Streak" pulverizer,
1—Fuller 12 x 20 pos. press. blower
2—Allis-Chalmers Inter-plane grinders, 100 HP
1—"Jay Bee" #4 hammermill,
9—Davenport 5' x 25' inclined "slop" screens
2—Warren 12" x 12" cent. pumps
250—Steel centrifugal pumps, 1" to 12", 1 HP to 150 HP
2—Aldrich vert. triplex plunger piston-type pumps, steam drive
100—Steel & stainless steel screw conveyors, up to 161' long
5000 HP—TEFC motors, 3/60/220-440/, to 150 HP
20—Steam turbines, to 150 HP
200—Steel tanks & bins, all sizes
12—300 amp. portable welders, elec. & gasoline

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CIRCLE S ON READER SERVICE CARD

# AMERICA'S LARGEST STOCK

## EVAP. – COLUMNS – STILLS

2—16,200 sq. ft. quadruple effect evap., calandria type, copper tubes, 4050 sq. ft. each effect, w/finishing pan, etc.
1—2085 sq. ft. Mojonnier triple effect stainless steel evaporator, w/preheaters, finishing pan, etc.
1—1025 sq. ft. Buflovak dbl. effect, stainless, #8-50-D
1—840 sq. ft. Buflovak dbl. effect, stainless, #7.5-42-D
1—710 sq. ft. Buflovak dbl. effect, stainless, #7-35-D
1—630 sq. ft. Struthers-Wells single effect, T316 SS, calandria
1—588 sq. ft. Buflovak dbl. effect, stainless, #6.5-29-D
1—553 sq. ft. Buflovak single effect, monel
12—185 sq. ft. T304 SS U-tube evap.-coolers
1—118 sq. ft. Stokes T316 SS U-tube steel
4—Vacuum pans, Rogers, Harris, etc. with int. coils
1—Still kettle, 5' dia. x 8' long, 1200 gal., int. coils
1—190" dia. x 13' high T316 SS scrubber column
1—96" dia. x 44' high copper beer still column
1—72" dia. x 46' high copper bubble cap column—VACUUM
1—60" dia. x 13' high T316 SS scrubber column

## RECENT STOCK PURCHASES

2—100 gal. T304 SS jkt. reactors—UNUSED
1—1800 gal. T316 SS jkt. & agit. reactor
1—American 42" x 120" dbl. drum dryer
1—Symons 2' standard cone crusher, 30 HP
3—Komarek-Greaves briquetting presses,160,000 psi
2—8' dia. x 56' long rotary kilns, ½" welded
1—Louisville 6' x 60' rot. steam-tube dryer
1—Davenport #3A dewatering press
1—4300 gal. T304 SS tank, 6' x 20', ASME 50#
3—300 HP Cleaver-Brooks PACKAGE Boilers, 150#
4—Buflovak 32" x 100" double drum dryers, chrome plated.
1—Stokes model #R single punch tablet press
2—#3TH Mikro Pulverizers, stirrup hammers
1—Raymond 50", 5-roller hi-side mill
1—J. H. Day #8, 150 gal. sigma blade Cinc. mixer
2—J. H. Day #5, 75 gal. sigma blade Cinc. mixers
1—Buflovak 110 sq. ft. Vacuum shelf dryer
1—Buflovak 98 sq. ft. Vacuum shelf dryer
1—Patterson 6' x 10' pebble mill, porcelain lined,
1—Baker-Perkins #15-UUMM, 100 gal. dispersion blade jacketed mixer, cored blades, 100 HP XP drive, compression cover.
2—Hardinge 7' x 36" conical pebble mills
1—Bird 32" x 50" T316 SS horiz. cent.
1—A.T.&M. 12" dia. susp. cent., T304 SS, perf.
1—Tolhurst 48" dia. sus. cent., T304 SS, perf.
22—Sharples #AS-16V super centrifugals, sludge disch. frame, Inconel, 3 HP.

# CLOSING OUT!

## CHEMICAL PLANT—ORANGE, TEXAS

## TYPE 316 STAINLESS STEEL EQUIP.

1—Struthers-Wells T316 SS 3500 gal. jkt. reactor, agit.
1—Struthers-Wells T316 SS 630 sq. ft. calandria type single-effect evap., 2" OD T316 SS tubes
2—Sharples #C-20 Super-D-Hydrators, T316 SS
1—Sharples #16-P Super-cent., T304 SS
1—Vulcan 110" dia. T316 SS bubble-cap scrubber column, 13' high, 10 trays
1—Vulcan 96" dia. T316 SS bubble-cap column, 37' high, 30 trays
1—Vulcan 72" dia. copper bubble-cap column, 46'-10" high, 40 trays—VACUUM
1—Vulcan 60" dia. T316 SS bubble-cap scrubber column, 13' high, 10 trays
3—Worthington 160 ton steam-jet vacuum refrigeration units, with baro. cond., etc.
2—Read 1800 cu. ft. T304 SS weigh hoppers, on scales, with shaker-conveyors, etc.
2—Bucket elevators, T304 SS, 5" x 3¾" T304 SS buckets on T304 SS chain: 60', 41' high c/c
2—18,000 gal. Aluminum tanks; 12' dia. x 31' OAH
2—American T316 SS blowers, 5600 cfm, 50 HP
2—Buffalo T316 SS blowers, 2330 cfm, 60 HP
1—1200 gal. horiz. steel still kettle, 5' x 8', ⅝" shell & dished heads, 320 sq. ft. int. coil
1—1960 sq. ft. T316 SS heat exchanger, 1" OD tubes
2—1450 sq. ft. T316 SS heat exchangers, 1" OD tubes
6—1400 sq. ft. T316 SS heat exchangers, 2" OD tubes
5—800 sq. ft. T316 SS heat exchangers, ⅝" OD tubes
1—800 sq. ft. T316 SS heat exchanger, 1" OD tubes
1—730 sq. ft. T316 SS heat exchanger, 1" OD tubes
19—T316 SS tubular heat exchangers: 510, 427, 410, 400, 390, 290, 277, 264, 250, 125, 54, 52, 50, 47 sq. ft.
1—Otis 5000# cap. elec. frt. elevator, 40' lift
4—Ing.-Rand #5HC, 6" x 5" T316 SS cent. pumps
3—LaBour self-priming T316 SS pumps; #15, 10

## TYPE 316 STAINLESS STEEL TANKS

3—2750 gal. vert., 7' x 8', ¼" shell & dished heads.
2—2300 gal. vert., 7' x 8', ¼" shell, ⅜" dished top, ⅝" at bottom. Paddle agit., 60 sq. ft. coil.
4—2250 gal. vert., 7' x 6'-3", vert., dished heads.
1—2100 gal. vert., 6' x 9'-10", open top, cone bottom.
6—685 gal. vert., 3' x 13', 120 sq. ft., int. coil.
15—100 gal. separator tanks, cone bottoms, 20# WP.
30—T316 SS tanks, 18 to 200 gal.

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# Chemical Manufacturing And Handling Equipment

## USED EQUIPMENT—EXCELLENT BUYS

## *FOR SALE*

**Gas Converter,** GENERAL ELECTRIC, G5, 4000 CFH, 400°F., 125#

**Lectrodryer,** PITTSBURGH Size 750, Type BWC, 100# W.P.

**Drycolene Producer,** GENERAL ELECTRIC, 2000°, 200 cu. ft., Type G2

**Impregnator,** 21" diameter, 11" deep, combination impeller and spinner (2)

**Screen Vibrator,** J. H. Day, 50" x 116"

**Hammermill,** swing hammer type, 4½" x 16" opening, 25 HP

**Hammermill,** swing hammer type DIXIE, 24" x 40" opening, 25 HP

**Tablet Machine,** New STOKES RD3X, 13/16" die, 7 ton

**Tablet Machine,** COLSON Model 1035, 1", 35 station

**Calandria Pan** 11'8" diameter, 13' high with vacuum pump

**Stainless Tank,** 42" diameter x 60" high, 10 gauge bottom discharge

**Tanks,** vertical and horizontals, 7500-8000 gallon

**Acid Proof Bronze Pressure Vessels,** 42" x 72", 125# pressure

**Muller Mixer,** BAKER PERKINS, 36" x 84" opening, 100 HP

**Mixer,** SIMPSON, 36" diameter tub, 5 HP

**Front End Loader,** LORAIN Moto-loader, 15 cu. ft. bucket, pneu. tires—Used

**Separator,** RAYMOND Single Whizzer Type

**Dust Collector,** AMERICAN Rotoclone, 5250 CF

**Extractor,** TOLHURST, 48", 7½ HP, 40 HP

**Hydraulic Pumps** and **Units**

**Blowers,** CONNORSVILLE Positive Pressure—all sizes

**Crane,** Model 83 BYERS, ⅜ yd., 38' boom, diesel, magnet, controls, and generator, 1947

**Crane,** Model 25 NORTHWEST, ¾ yd., 35' boom, diesel

**Crane,** Model 79 LORAIN, 1¾ yd., 60' boom, diesel

**Crane,** OHIO Locomotive, 30 ton, 8-wheel, diesel, 50' boom, outriggers, generator, new 1954—LIKE NEW CONDITION.

**BEHR MACHINERY & EQUIPMENT CORP.**

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CIRCLE U ON READER SERVICE CARD

# LIQUIDATING

10 MILLION DOLLAR **CHEMICAL PLANT** NORTH JERSEY AREA

## TYPE 316 STAINLESS STEEL EQUIPMENT

1—2600 gals. type 316 SS vertical vacuum receiver
4—Vert. type 316 SS activated carbon absorbers, 5'4" dia. x 16'
1—Struthers Wells 75 gal. type 316 SS, 500# pressure vessel, ASME code National Board
2—Rubber lined horiz. storage tanks, 5500 gals. working pressure 45#
6—Rubber lined vertical storage tanks, 4500 gals. working pressure 45#
2—Rubber lined vertical storage tanks, 2500 gals., working pressure 45#
1—Type 316 SS packed column, 18" x 11' 7½", working pressure 45#
2—Buflovak type 316 SS jacketed rotary vacuum dryers, 5' x 30', complete with 25 HP explosion proof motors and drives
3—Type 316 SS Ter-Meer continuous type centrifuges, 4' dia. bowls, complete with motors
2—Readco stainless steel horiz. blenders, 450 cu. ft. working capacity, complete with 75 HP motors
3—Mikro Model 3TH stainless pulverizers, complete with 40 HP explosion proof motors
3—Nash SH-6 SS vacuum pumps, complete with 20 HP motors
2—Shriver 42" x 42" wooden P & F filter presses with hydraulic closing device
3—Nash T5-12 vacuum pumps, with motors
5—American type 316 SS blowers, Model MD, size 27"
2—Aldrich Groff type 316 SS hydraulic triplex pumps, size 2¾" x 4" at 500 psi
2—Powell type 316 SS, 10" hyd. oper. flanged and gate valves
3—Tyler type 38 tandem SS Hummer screens, size 42" x 9'8"
3—Williams type 316 SS hammermills with 100 HP motors
3—200 gals. type 316 SS jacketed kettles
500 tons of type 316 SS pipe, fittings and valves, from 2" to 8"
500 tons of structural steel

**R. GELB & SONS, Inc.**

U. S. HIGHWAY 22, UNION, N. J. MUrdock 6-4900

CIRCLE W ON READER SERVICE CARD

# Chemical Plant Sale

## EVERETT, MASS.

B&P Ter Meer S30 Centrifuge 316 S.S.
Sharples C-27 Centrifuge 316 S.S.
Eimco 4'x2' Rotary Dewaterer 316 S.S.
S.S. Centrifix Eliminator 42"x12'6"
Sparkler 33-D-12 Filter, 316 S.S.
Sparkler 18-D-8 Filter, 316 S.S.
Swenson 24"x20' jkt. S.S. Crystallizers
Swenson Evaporator 425 sq. ft. Stainless
Absorber Column 18'x66' Stainless
Bubblecap Columns 7'x25'-8 trays; 5'x88'-35 trays; 3'x38'-35 trays
Baker Perkins 18DIM 300 gal. Mixer
100 Steel Tanks 1000 to 350,000 gal.
Lummus Furnace 4 Million BTU
11'6"x34' & 14'x24' Crude Still, welded
Penna. SX13 Hammermills, 400 HP
Heil Patterson Crushers, 100 HP
Koppers 36"x42"-2 Roll Crushers
Centrif. Blowers 23M; 29M; 50M, CFM
10,000 ft Trough Conveyor 30"; 36"; 42"
Stainless Centrif. Pumps 2"x2" to 6"x5"
Patterson Uni-Power Drives 1 to 20 HP

## STAINLESS TYPE 316 TANKS

17,500 gal. 15'x16'OA Flat top, cone bot.
11,500 gal. 12'x15'OA cone bot. 15 HP Agit.
10,500 gal. 10'x23'OA dish top, cone bot.
5,200 gal. 9'x11' open top, flat bot.
4,000 gal. 8'6"x10'6"OA Dished Heads
1,000 gal. 5'x8' open top, cone bot. 3 HP Agit.
400 to 850 gal. (10) Some Agitated

**HEAT & POWER CO. INC.**

60 E. 42nd St., N. Y. 17 MU 7-5280
*Sales Agents for Harcon Lipsett Joint Venture*

CIRCLE V ON READER SERVICE CARD

## DIESEL LOCOMOTIVES & CRANES

9 Gen. Elec. 20, 25, 45, 65, 80 & 100-Ton
25-Ton Industrial Brownhoist, 60' Boom Crane

## PLANT EQUIPMENT

4' Traylor TY Gyratory Crusher
2—Wemco 2M-HMS Plants
No. 5060 Dixie Mogul Hammermill 800 HP
No. 1 Sturtevant Rotary Fine Reduction Crusher
72" x 28" Madson Rotary Dryer
F55 Syntron Grizzley Feeder
10—1½ & 2 Yd. V-Shape Dump Cars
2—5' x 8' KVS Air Swept Ball Tube Mills
Ball Mills: No. 56, 6' x 4', 6' x 9' & 7' x 22'
Hardinge Mills: 3'x8", 3'x24", 6'x48" & 10'x48"
Rod Mills: 4' x 11', 6' x 12' & 7' x 15'
Jaw Crushers: 10" x 20", 14" x 28", 15" x 24", 18" x 36", 30" x 36", 48" x 72"
Crushers, Fine Reduction: 22", 2', 3', 4', 5½', & 7' 848 Cone, & 40" x 22" Roll
Rotary Dryers: 3'x30', 5'x30', 6'x70' & 8'x80"
Rotary Kilns: 30" x 36', 6' x 70' & 9' x 160'
Roto Louvre #207-10 Type 316 SS, Link Belt 60—1½, 2 & 4 yd Dump Cars
Laboratory Rotary Kiln, 30" x 30', Complete
4' x 10' Tyler-Hummer Electric Vibrating Screen
2'x6' & 3'x12' Seco Single Deck Vibrating Screen
8' & 16' Gayco Centrifugal Air Separator
24" x 95' Hewitt Robins NEW Truss Belt Conveyor
6—30" x 32" Dings Magnetic Head Pulleys
690, 2200 & 3068-I.R. Compressors
41000 CFM Sly Dust Collector
2000 Tons Steel Sheet Piling, 10' to 78'

WANT BUY DRYERS — KILNS — CRUSHERS

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## WIRE US COLLECT!

### 3—BRIQUETTING PRESSES IN STOCK

Komarek-Greaves Model 21-94. 160,000# per square inch pressure. Roll size 9½" face x 21½" dia. 75 HP Motor. High pressure feeders

**ME MACHINERY AND EQUIPMENT CO.**

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CIRCLE Y ON READER SERVICE CARD

**New 4000 gal. Stainless Tank**
**Spr. Wald 10,000# Spiral Mixer**
**Buffalo 32"x90" Double Drum Dryer**

*SEND FOR LISTINGS*

**STEIN EQUIPMENT CO.**

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CIRCLE Z ON READER SERVICE CARD

# UP A TREE?

## GET DOWN TO EARTH!

# BUY GELB

## CHEMICAL PROCESS EQUIPMENT

**1—Buflovak 24"x36" chrome plated double drum dryer with SS contact parts, NEW**
**1—Pfaudler 750 gal. glass lined jacketed reactor complete with impeller type agitator and drive**
**1—Proctor & Schwartz stainless steel apron dryer, 2'x20'**
**2—Mikro Model 3th SS pulverizers complete with 40 HP explosion proof motors**

### AUTOCLAVES, KETTLES AND REACTORS

1—Pfaudler glass lined jacketed reactor, 100 gals., complete with impeller type agitator and drive
1—Pfaudler type 316 SS jacketed reactor, 5 gals., complete with impeller type agitator and drive, 102 psi jacket, 60 psi internal
1—Patterson 10 gal. autoclave complete with anchor type agitator and drive, 600 psi internal, 125 psi jacket
2—Monel 2500 gal. jacketed autoclaves, 175# jacket 175# internal pressure
1—2500 gal. stainless steel open top jacketed kettle
1—Van Alst 250 gal. SS jacketed kettle, complete with SS column and condenser
2—Blaw-Knox 600 gal. steel reactors, complete with double motion agitators and drives. 50# jacket, 50# internal

### DRYERS

1—American 42" x 120" double drum dryer, ASME, N.B. complete with drives and motors
1—Buflovak twin drum chrome plated dryer, 32" x 90"
1—Allis Chalmers SS 6' v 50' rotary dryer, complete
10—Allis Chalmers rotary dryers, 6' x 50' and 7' x 60'
3—Link Belt steel roto louver dryers, Model 207-10, 310-16, 604-20
1—Stokes Model 59DS steel rotary vacuum dryer, 5' x 30'
2—Hersey SS rotary dryers, 3' x 16'
1—Buflovak SS jacketed rotary vacuum dryers, 3' x 15'
3—Buflovak steel jacketed rotary dryers, 3' x 15', 5' x 20', 5' x 35'
1—Traylor 4' x 10' rotary dryer
1—Western Precipitation Corp. S. S. pilot plant spray dryer, Type N-2
1—Bowen SS pilot plant spray dryer

### FILTERS

3—Dorrco rubber covered filters, 6' x 2'
12—Sweetland #12 filters with 72 SS leaves
1—Niagara SS filter, Model 510-28
1—Oliver horizontal filter, 3'
1—GATX SS pilot plant filter, 2' x 6"
1—Oliver SS rotary vacuum pressure precoat filter, 5'3" x 8'
1—Oliver SS rotary vacuum precoat filter, 3' x 2'
1—Oliver SS rotary vacuum filter, 3' x 4'
10—Shriver plate and frame filter presses, 12" to 42"
1—Shriver aluminum 30" x 30" P&F filter press, 30 chambers

### CENTRIFUGES

1—Fletcher 48" SS under-driven centrifuge, complete with perforate basket and motor
1—AT&M 48" suspended type centrifuge, complete with plow, motor and imperforate basket
2—Fletcher 40" rubber covered under-driven centrifuges with perforate baskets and motors



*THE GELB GIRL—NOVEMBER 1960*

1—Tolhurst 26" SS under-driven centrifuge complete with perforate basket and motor
2—AT&M type 316 SS suspended type centrifuges, complete with 26" perforate baskets, plows and motors
4—Tolhurst 40" center slung rubber covered centrifuges, with perforate baskets and motors

### MIXERS

1—Banbury #1 mixer, chrome plated rotor with 50 HP motors
1—Robinson SS 125 cu. ft. horiz. double ribbon blender
2—Readco SS horizontal rotary blenders, 450 cu. ft.
1—Cleveland SS double cone blender, 85 cu. ft. complete with drive and motor
2—Sturtevant #7 dustite rotary batch blenders, NEW
1—Richmond Engr. type 316 SS 40 cu. ft. horiz. double ribbon blender
15—Robinson type 304 SS horizontal blenders, 255 cu. ft.
1—Baker Perkins Size 16, Type UUEM, 150 gal. jacketed double arm dispersion type mixer, complete with compression cover and 100 HP motor
2—Baker Perkins 20 gal. SS jacketed vacuum double arm mixers
1—Stokes SS granulating mixer, Model 21-J

### MISCELLANEOUS

1—Vulcan SS bubble cap column, 4' x 25 plates
1—Badger type 316 SS bubble cap column, 42" dia. with 11 trays
1—Badger type 316 SS bubble cap column, 36" dia. with 8 trays
4—Davis Engineering Carpenter 20 heat exchangers, 125 sq. ft., NEW
1—Struthers Type 316 SS heat exchanger, 330 sq. ft.
1—Condenser Service type 316 SS heat exchanger, 350 sq. ft.
3—Badger type 316 SS heat exchangers, 500 and 600 sq. ft.
1—Downington type 316 SS heat exchanger, 750 sq. ft.
4—Patterson type 316 SS condensers, 200 and 300 sq. ft.
1—Griscom Russell stainless steel heat exchanger, 900 sq. ft.
2—Swenson type 316 SS vacuum crystallizer, 3'6" x 12', 2' x 12'
3—Williams type 316 SS hammermills, Model AK
1—Ross 6" x 14", 3 roll paint mill, complete

**4—Alloy Fabricators type 316 SS vacuum receivers, 2600 gal.**
**2—Struthers Wells type 316 SS jacketed reactor, 2000 gals.**
**7—Western States 40" type 316 SS suspended type centrifuges, complete with perforate baskets, plows and 40 HP motors**
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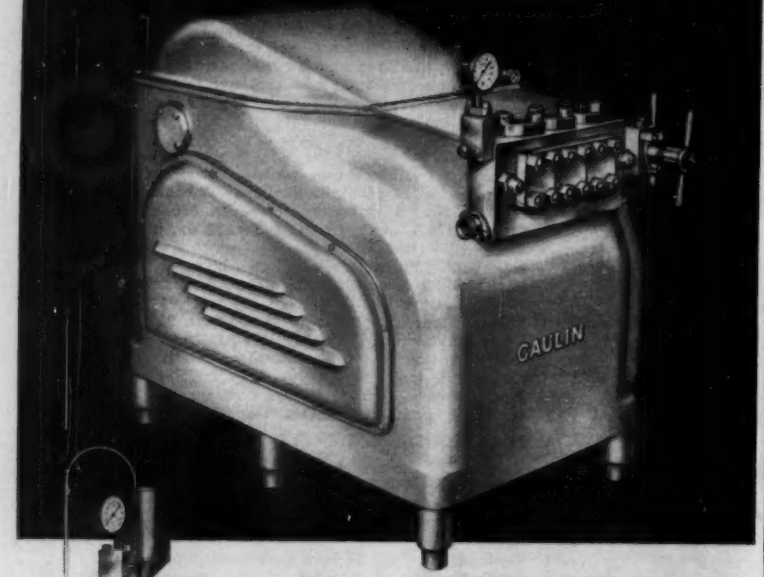


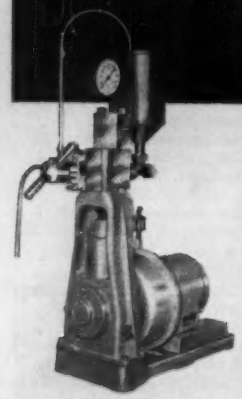
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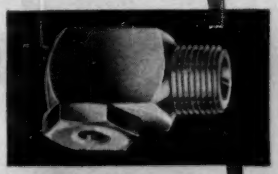
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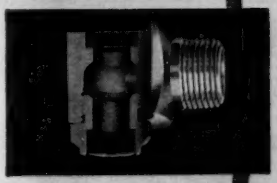
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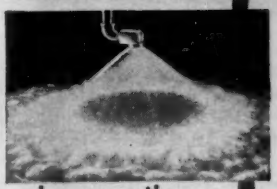
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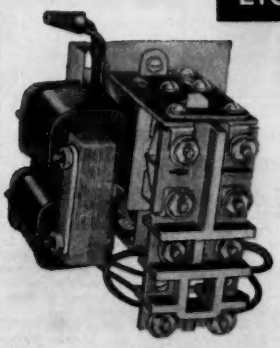
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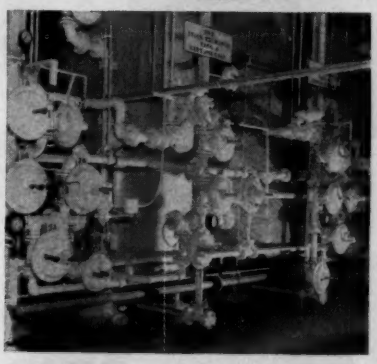
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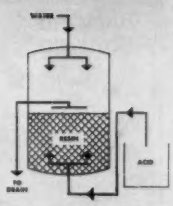


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* U.S. Pat. 2,891,007

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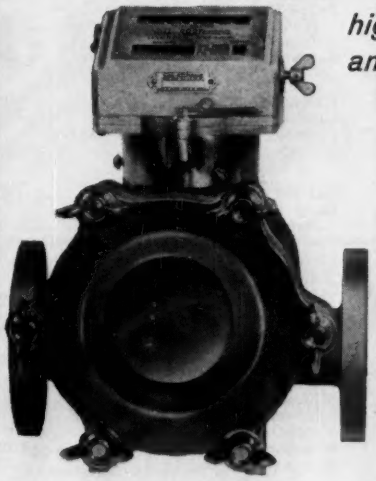
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## "LOW FIRST-COST VS. LOW ULTIMATE COST" CONTROVERSY DEMANDS UNDERSTANDING OF ECONOMICS

In the price-economy of competitive bidding, especially in the field of capital process equipment, the historic struggle between long-range economy and "low-dollar" first-costs has been brought into sharp focus by modern cost engineering practices. Calculating and evaluating the eventual profitability of such equipment can no longer be a matter of "guestimates" or conjecture. The practical facts of economic life must be faced. Process companies must scrutinize closely ALL the factors concerned in engineering, construction, installation and **continued operation.** Unanticipated maintenance or replacement costs can quickly increase the cost of operation, and supposed first-cost savings are thus virtually or entirely eliminated.

Why is "cost engineering", or engineering economics an exotic term to most engineers? This is the Age of Specialization, and so it follows, given free rein, over-design frequently occurs. At the other extreme is the "gimmick pushers" approach that anything will suffice if the price is right. Between these two extremes the dedicated engineer must establish parameters that will satisfy to the highest degree the three M's of industry — Men, Materials, and Means.

Faced with these problems, then, how can we best solve the problem: "When is a low bid really low?" A multitude of answers must contribute to the total solution. What is the longevity of the equipment? How many spare parts will be required? How often will shut-down be required to make repairs? How much time will be required? What are the economic consequences of shutting down the continuous flow operation?

Cost-and-economy consciousness is of prime concern in each stage of process equipment manufacture — from design through fabrication, and finally to installation and operation. All aspects of true costs must be considered, not simply those which are obvious at the moment.

Infinite care must be exercised when considering the following:

**Design** — a major factor involved in the creation of process equipment. During the design phase, the greatest waste often results from a desire to be conservative. True economy in design must, therefore, satisfy the criteria which apply to each particular process.

**Payout** — management is interested in equipment that will pay out in the shortest period of time, and this would seem to indicate buying only what is required, at the lowest cost, at the time it is needed. Again, however, the life of the equipment, its maintenance, shut-down time and other factors cannot be ignored.

**Excess-capacity** — each piece of equipment must be designed for its specific use in order to obtain maximum benefit of capital dollars. Excess-capacity equipment, purchased without specific anticipation of future expansion, represents idle investment dollars.

Today's fierce competition requires the concentrated application of both short and long term economies, from design through final construction and operation. **This subject is treated in more detail in a new booklet, "Low Ultimate Costs and Low Dollar Bids Are Not the Same", and single or multiple copies are available by writing WESTERN SUPPLY COMPANY, P. O. Box 1888, TULSA, OKLAHOMA . . . where the teamwork of science, engineering, technology and economics are combined to provide the optimum in the "cost-engineered" heat exchangers in your future.**

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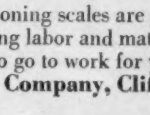


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RS-12

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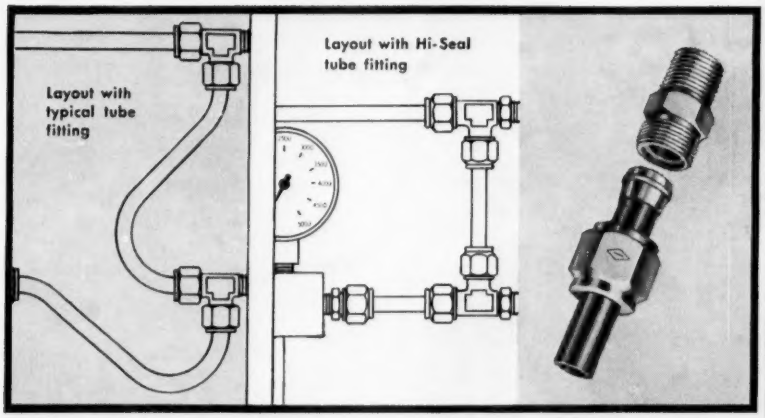
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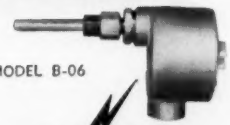
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* *Model B-06 shown features unitized explosion-proof construction, plug-in components, tank side mounting.*

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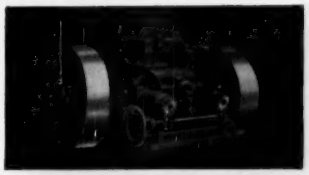
# Take Guesswork Out of Lab Crushing & Grinding

**Sturtevant Design Provides Easy Access for Cleanouts — Returns Complete Sample**

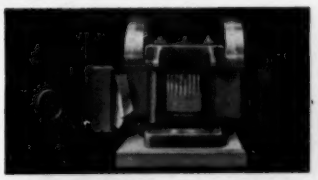
In seconds, because of "Open-Door" accessibility, all Sturtevant crushing or grinding parts are exposed for thorough cleanouts. 100% sample return is easy to secure.

Sturtevant laboratory machines are ruggedly constructed — design, based on production models, gives top lab or pilot performance.

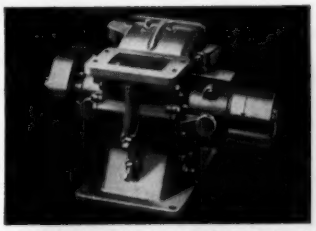
Send for Bulletin No.067, which gives full description of all Sturtevant laboratory machines.



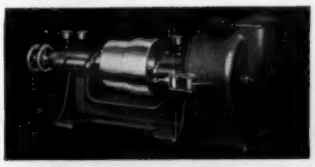
**Lab Crushing Rolls:** Special lab design. Two models: 8 x 5 in. and 12 x 12 in. rolls. Capacities to 10 tph. Both models adjust down to 20 mesh. Tires of high carbon forgings. Automatic feeder, adjustable controls.



**Lab Jaw Crusher:** Crushes hardest rocks at ½ to ⅛ in. settings. Roll jaw action — no clogging. Feed opening 2 x 6 in. Capacity to 1900 lbs. per hr. at ½ in. setting. Instant adjustment. Manganese jaws, reversible shield.



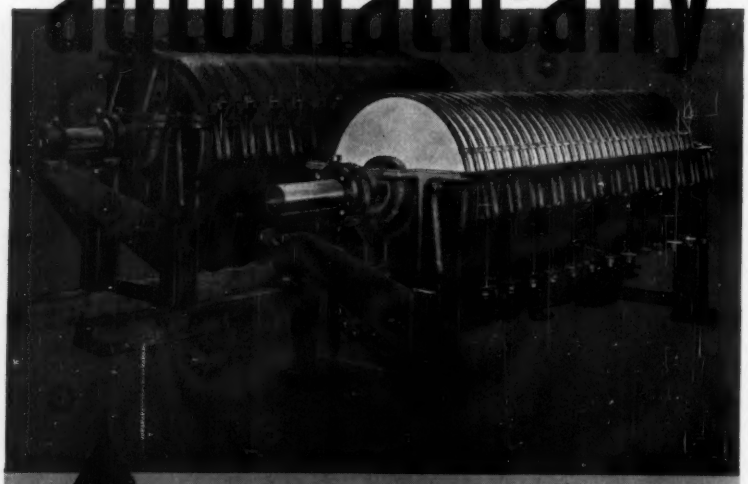
**Lab Swing-Sledge Mill:** 5 x 6 in. opening takes soft, medium, tough or fibrous feed. Capacity to 1 tph. Fines regulate from 1 in. to 20 mesh. Choice of gratings, hammers (or knives).



**Sample Grinder:** Disc type grinders for dry, friable soft or medium materials. Three sizes — 6 in., 10 in., and 14 in. take feed as coarse as ¼ in. Produces 100 mesh fines at capacities to 200 lbs. per hr. on largest model. Regulate 10 to 100 mesh. In-operation adjustment.

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automatically



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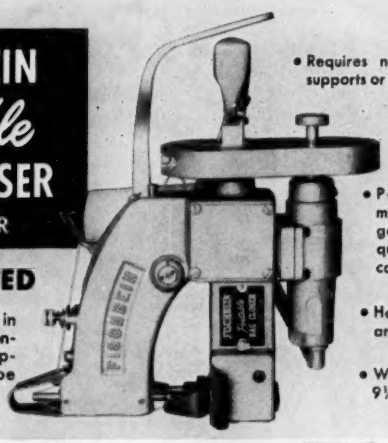

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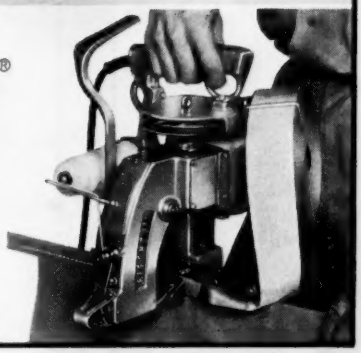
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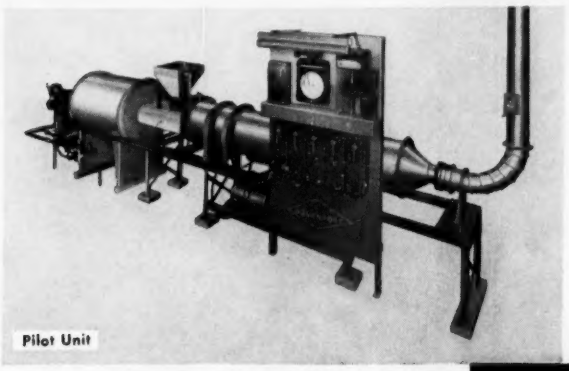


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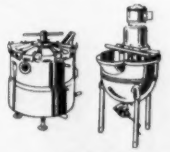



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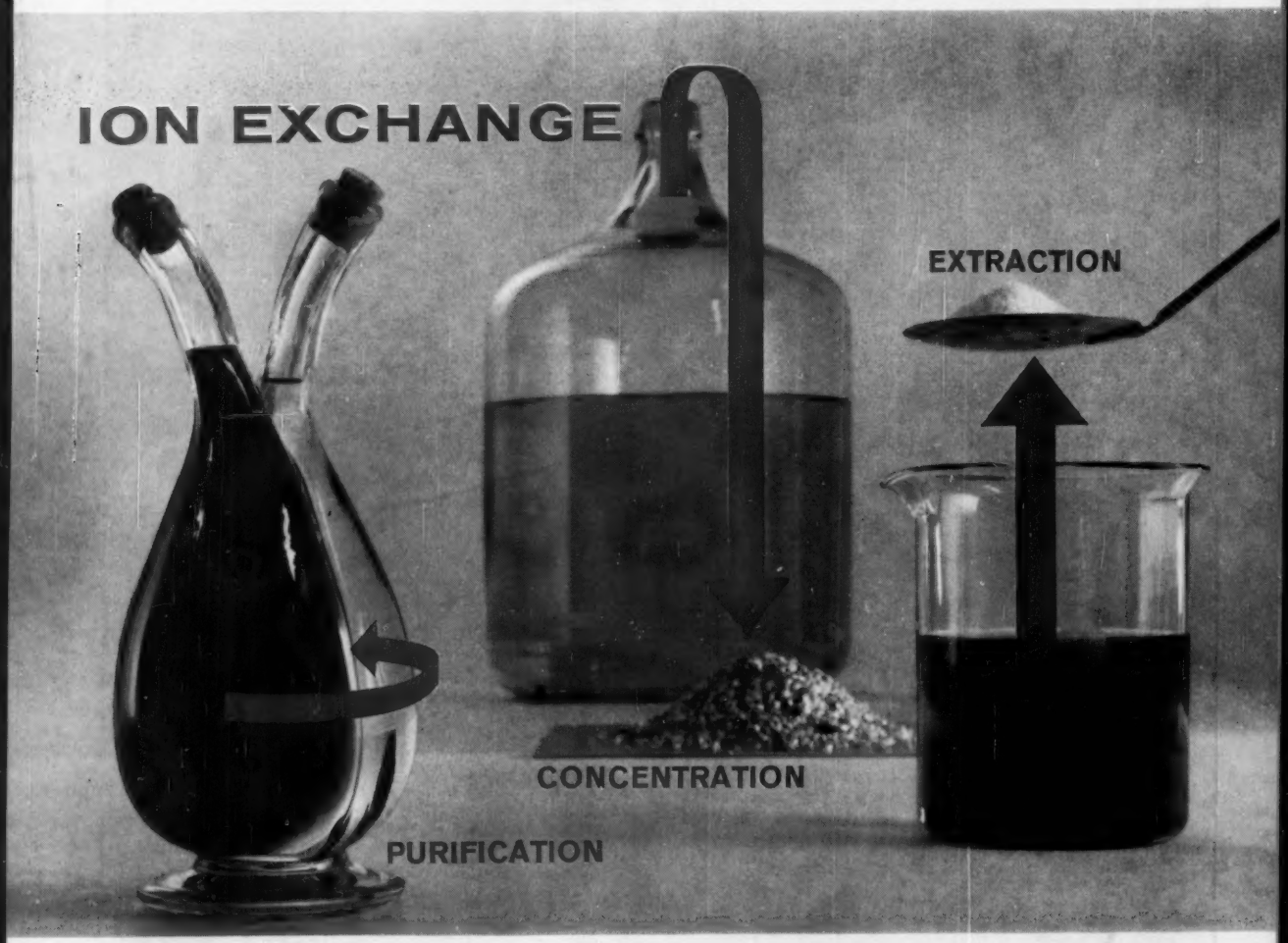
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